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Unloading iron ore at Cleveland

December 8, 1930

Yesterday and Today

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At the left is pictured the ruin of a Colorado smelter, erected in the days when water power was largely relied upon. There was little to work with then, and processes were necessarily crude.

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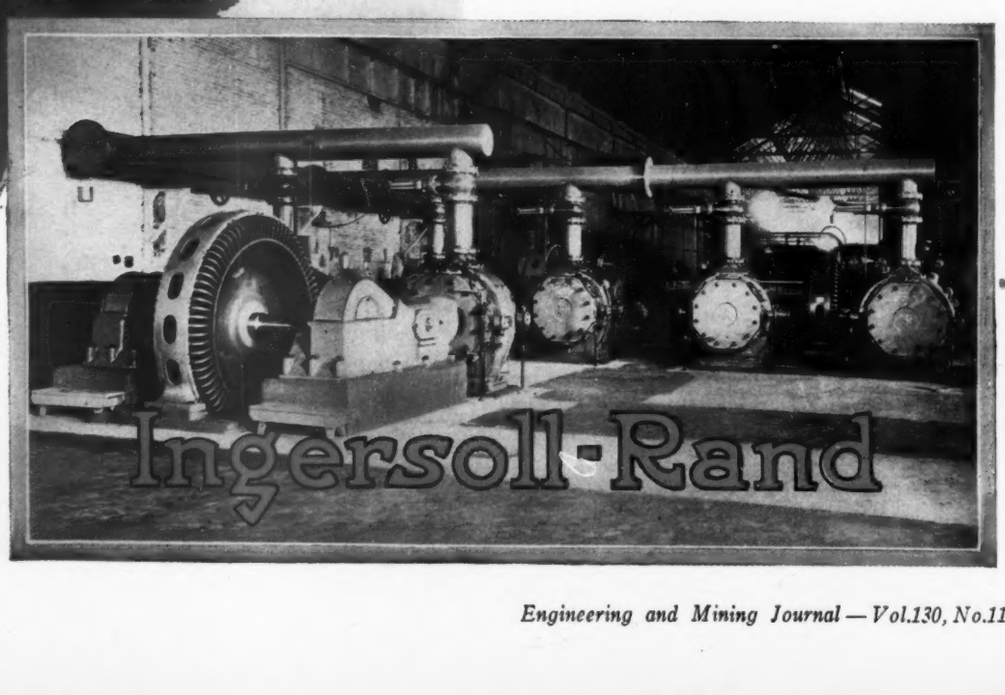

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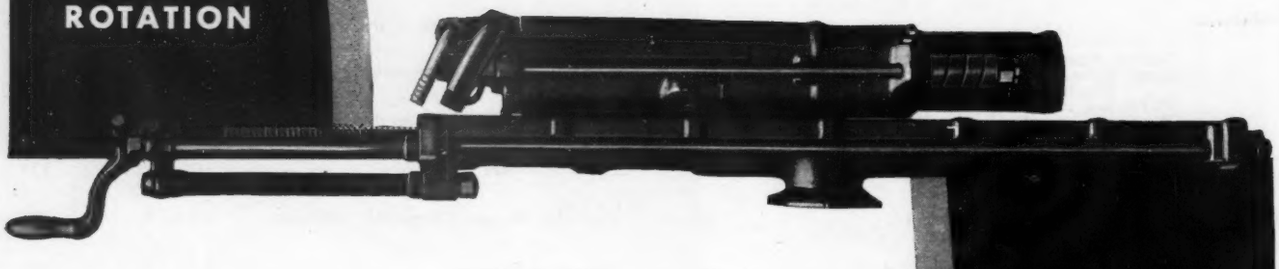

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ENGINEERING AND
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A. W. ALLEN, *Editor*

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New York, December 8, 1930

Latent Possibilities of the Proletariat

TO ESTABLISH a line of demarcation between the amateur and the professional is necessary to a preliminary study of the relative influence of either on human progress. In a recent communication to the Mining and Metallurgical Society of America, Mr. H. H. Knox provides food for thought and material for discussion. Frequent reference to this period as the age of research suggests that all advancement is the work of specialists, he reminds us. However, amateurs in the sciences and industrial arts have contributed much of importance, although the so-called working classes are responsible for an insignificant proportion, if their numerical status be taken into consideration.

Mr. Knox lists thirteen prominent inventors—Watt, Arkwright, Whitney, Fulton, Stevenson, Morse, Howe, McCormick, Edison, Westinghouse, Langley, and the Wright brothers—and finds that only three belonged to the laboring class when their inventive careers began. However, to select thirteen leading inventors is as difficult a task as to name half a hundred "rulers" of the United States. Moreover, is it possible to say when an inventive career began? Have not many great achievements been due to the groundwork of private thought and the development of a creative philosophy many years before the individual, by perseverance and self-denial, graduated from the so-called laboring class? Invention is the product of the specialist in much the same way that the accumulation of wealth is a characteristic of the capitalist. But the achievements of individuals in either class may usually be traced to humble beginnings.

Opinions may differ on the subject, but contact with men in all phases of employment in the technical industries results in the conclusion that inventive ability does exist in the lower strata of employment, although confined to a small minority. In most instances this initiative is choked to extinction by the "superior" officer, who resents the elevation of a subordinate by recognition or reward. Or success may be denied to the inventor because of subsidized propaganda, designed to deflect attention from the pioneer and to focus the spotlight on the magicians of the research laboratory.

Few self-help inventors have achieved financial success, because of the practice of a philosophy that is impatient or contemptuous of business outcome, in distinct contrast to that which spurs effort in modern business. Industry might well offer greater inducements to its thinkers, even those in subordinate positions. Mr. Knox, whose remarks inspired these comments, avers that Napoleon Bonaparte made more than a gesture of encouragement when he told his troops that each one of them carried a marshal's baton in his knapsack.

Metallurgy Paves the Way for High-Pressure Technology

THE presentation of the 1930 Grasselli Medal to Dr. Per K. Frölich, of Standard Oil, for his achievements in the field of high-pressure synthesis, again focuses attention on this important development in chemistry, which discloses so many new fields of industrial activity. In his address at the official presentation, the medalist drew an enticing picture of the future of chemical industry, and pointed to the remarkable opportunities offered for synthesizing, directly from the elements, complicated organic compounds of great commercial value.

The old adage that a workman is not better than his tools has lost none of its significance in the present age. With startling results produced in the laboratory, and important reactions in his grasp, the chemist made his appeal for equipment that would allow him to transfer the experiments to an industrial scale. Again the metallurgist was able to come to the aid. Alloys were developed that were capable of withstanding immense pressures at high temperatures. Large vessels, of a capacity as high as 200 tons, are used for a pressure of 1,000 pounds at red heat, and forgings are made for pressures up to 15,000 pounds. Hand in hand with this development has come an improved welding technique, most effective in reducing leaks and failures in high-pressure work. Efficient welding is also permitting a great flexibility in design and construction, a feature of special importance in chemical engineering, which probably more than any other branch of engineering is subject to frequent changes in technique.

Various types of nickel-chromium iron and steel stand out prominently among the alloys that have found application in this work. Nitrogen fixation, ammonia oxidation, distillation and cracking, hydrogenation, production of synthetic solvents—these are some of the developments in the chemical field made possible by the use of this new equipment. The progress made is well illustrated by the fact that the present investment in high-pressure plants in the United States is about a hundred

million dollars, with a yearly output valued at fifty million dollars. Such remarkable progress in a comparatively short span of years is only an indication of future possibilities. It gives promise that the dreams of today will become the realities of tomorrow.

Electrical Maintenance Engineer—the Plant Physician

MODERNIZATION and intelligent maintenance together serve to insure high over-all plant efficiency. A recent address by Mr. R. H. Rogers, of the General Electric Company, at a convention of the Electrical Maintenance Engineers at Cedar Point, Ohio, has thrown new light on and stressed the importance of this subject.

In this age of mechanization, the electrician is in a strategic position to foster modernization by urging the use and proper maintenance of efficient plant machinery. Intelligent upkeep means something more than repair to keep the unit in running order until the defect is again in evidence. A thorough investigation should be made into the cause of every failure, to insure avoidance of repeated breakdown. Of vital importance is the need for periodic studies of electric power equipment. The proper selection of any electrical unit—be it a motor, battery, or transformer—is the secret of plant efficiency, high power factors, and low power charges.

Untiring research work has improved electrical machinery to such an extent that the replacement of obsolete equipment with modern units effects an obvious economy. Maintenance of such modern units has been simplified by improvements in design and construction. One phase of the replacement problem has been met by modification in composition: Insulated parts now retain their qualities longer than formerly.

A diagnosis by the plant physician—the maintenance engineer—and the co-operation of those in executive authority in putting his recommendations into practice, will go far in the attainment of efficient mechanical operation and low operating cost.

Obligations and Privileges of the Wealthy

DIVIDENDS paid by mining corporations are diffused into many hands. The amount going to any single individual may be relatively small, and not a matter of public interest. In the days of the Comstock, however, the wealth coming from the mines, though likewise diffused, was also concentrated in the hands of a few, some of whom used it in the aggrandizement of personal vanity, whereas others spent it in a more constructive way. John W. Mackay, who made much money from the Consolidated Virginia bonanzas, used his gains from the mining industry in the development of transatlantic communication, and his son, Mr. Clarence H. Mackay, continued his father's program. After John W. Mackay's death, his widow and his son took an interest in the University of Nevada, then a collection of unadorned brick buildings on a wind-swept terrace overlooking the alfalfa fields about Reno, with a young faculty, an ambitious president, and a small student body truly born of the State. Mr. Mackay and his mother have transformed this institution until it is now one of the beauty spots of Nevada, with buildings, facilities, faculty, and student body that command attention. The interest of the Mackays has also stirred the pride of other Nevadans, and the State has generously supported the university.

Only recently Mr. Mackay presented the university with a magnificent science hall. At the laying of the cornerstone he said: "First, I am the son of a self-made man; secondly, I am the son of a pioneer in the pioneer State of Nevada; and, thirdly, I am moved to turn back to the soil what was taken from the soil in order that future generations may benefit in degree what I and mine have inherited from the soil of Nevada. The word 'pioneer' is, to my mind, one of the most distinctive and universal of words. It spells vision, courage, sacrifice—qualities that are characteristic of the pioneers who blazed an ineffaceable trail in the progress and development of this State and country."

A worthy son of a worthy pioneer returns to the State a portion of the wealth won by his father. Thus the Consolidated Virginia bonanza has rendered service by the interchange of knowledge and the education of the youth of the State in which its riches were developed.

Technical Education and Sociological Development

AT THE dedication of additions to the physical plant of the technical school, more and more is it becoming the custom to follow the dedicatory exercises with a series of conferences between representatives of the technical schools and those of industry. Also, one of these conferences is invariably devoted to discussion of the relationship between the industries and the schools. Such was the general program at the recent dedication of the James Ward Packard Laboratory at Lehigh University. Five representatives of industry told the assemblage at a conference, held the day following the formal dedication, "What Industry Expects of the Technical Schools," and three educators outlined "What the Technical Schools Expect of Industry." The sum total of these addresses was, in effect, that, although some "expectations" have been fulfilled or were on the way to being fulfilled, many others necessitated for their accomplishment a closer and more extensive co-operative effort between the two groups than exists at present. Whether or not each individual recognized fully the responsibilities incurred by his group is open to question. However, a ninth speaker, qualified to represent both groups, but speaking under the auspices of the second, may be said to have indicated the major common problems and objectives. Reference is made to the address of Mr. David Ross, president of the board of trustees of Purdue University and president of the Ross Gear Company.

Mr. Ross' views were strikingly significant, as might have been expected. After pointing out the more important responsibilities of each group, as well as those that devolve upon boards of trustees of the schools, he

discussed the sociological aspects of technical education. "The use of power and automatic mechanisms," he said, "forces a new responsibility on all those charged with formulating the policies for future technical training. A holiday in research and invention has been proposed, in order that humanity may catch up. How much better it would be boldly to face the problem and solve it for humanity in general rather than for a few. The time is past when boards of control of educational institutions may regard their positions as honorary. They must realize that they have before them the greatest research problem that civilization has ever faced; that is, to see that all humanity may have and enjoy the results of decreased effort with increased comforts and aspirations of living." Looking into the future, he added, "When a civilization finds its people producing the required maximum during a given work period, then the rest period or time of idleness will be prolonged. With the perfectly automatic mechanization of production, but few hours per week will be needed to supply the wants of humanity. One great problem for all far-seeing educators is that of the profitable employment of leisure."

Such remarks are impressive, especially when uttered by one who is unstintingly devoting to the advancement of technical education and a recognition of its importance those same talents that have secured for their possessor an unusual success in industry. To say that the future depends on the educational opportunities of today, is, perhaps, trite. Few will deny, however, that, in the light of Mr. Ross' statements, technical education is an increasingly potent influence in determining the character of the civilization of the morrow. As such it is deserving of the studious consideration of the best minds available.

Progress Made in International Agreement

A RECENT BULLETIN of the Institution of Mining and Metallurgy contains the final report of the representatives of that society on the Sieves and Screen Committee of the British Engineering Standards Association, known as the B.E.S.A. It marks another step in the slow achievement of international agreement on fundamental matters, such as weights and measures. The problem before the committee was to meet the objections that have been raised against what is known as the I.M.M. series, officially recommended by the Institution in 1907, but displaced to a large extent outside the British Isles by the Tyler series, proposed in 1913.

The committee has favored the Tyler series, but a compromise has been considered advisable because of the dimensions of the British Standard Wire Gage compared with the gage used in the manufacture of screens using the American series. The major disadvantages of the I.M.M. series have been obviated in the new British screens, and the major advantages of the Tyler series have been incorporated. Although the apertures of the Tyler series and the new British series are now almost identical, the mesh designations differ, because of the lack of uniformity in wire dimensions in vogue in England and in America. This should be the next subject for international agreement.

The Diviner Continues His Witching Way

BELIEF in the art of divining survives, though the subject was well aired in a bulletin issued by the government a few years ago. Proof necessary to discredit the diviner's claims is difficult to secure. A negative must be proved. A convincing way would be to assemble the champion dowsers of the world, turn them loose on unknown ground to do their best with whatever instruments they might choose to use, and then check the accuracy of their decision by drill hole, well, or shaft. One of the country's research foundations might make provision in some future budget for an extensive test of this kind. At present, it would help to provide employment.

In the absence of the desired proof, many incline to tolerate the diviner and his brethren. The amazing discoveries of science make them loath to deny that there may be more things in heaven and earth than they have dreamed of in their philosophy. Such seems to be the attitude of a German manufacturer of mining machinery, who publishes in his house organ "an interesting article" recording the experience of one Herr Hirsch as a "water and mineral diviner." The publisher admits the subject is debatable and hopes that the notes given will stimulate the readers of his paper to exchange opinions. One might reply that opinion has already been widely expressed on the subject; that what is needed is a showdown for the diviners. By and large, the latter have never really proved their claims. On a few occasions they have indicated the presence of the mineral sought, but this is not adequate proof. More likely, in each instance, it was a lucky guess. Given one hundred guesses as to the presence of oil or water in a district where these substances are known to occur, anyone might hit the bull's-eye at least once or twice, especially if familiar with the discoveries already made in the locality.

Diviners offer no explanation of their method of procedure, save to claim the possession of a "gift," supernatural or otherwise. Nothing thus far discovered in the realm of science indicates that man can possibly "sense" the presence of matter, near-by or distant, save through the medium of sense perception. Belief in divining had its origin in the mind that also accepted witchcraft and magic as actualities. It is a hang-over from distant, less scientific times. The marvelous discoveries of the present day—all susceptible of scientific explanation, but, to a great extent, comprehended by the masses only dimly, if at all—have made it all the easier for charlatan and faker to get a following of believers.

This is not to say that the diviner is necessarily a fraud. In many cases he may be the product of ignorance and self-delusion. Let John Plowman monkey with a witching stick and thereby actually locate a supply of running water, and he and his neighbors will most likely assume a relationship of cause and effect, and in the course of time become convinced that the diviner has a "gift." Moreover, millions of people, formerly ignorant of physics, have through the radio become aware that energy can traverse space in invisible ways, producing definite effects at a distance. To many of them the assertion of a diviner that each mineral gives off its peculiar ray or wave of energy, which brings to him in some way the knowledge of its presence, sounds "scientific." But even this leaves the forked twig or its substitute devoid of explanation.

Electric Pulp Sampling

Thomas Jordan
University of Utah, Salt Lake City

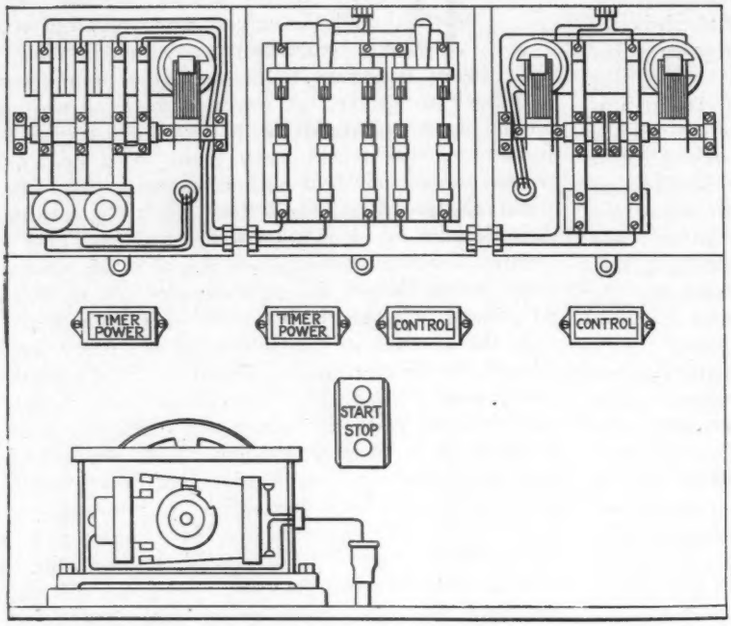


Fig. 1—General arrangement of timing station

The design, construction, and operation of a successful system of automatic samplers, controlled from a central timing station, at the Utah Copper Company's plant at Garfield

IN 1923-24, a complete system of automatic electric sample cutters was installed in the concentrating plants of the Utah Copper Company at Garfield, superseding several hydraulic samplers. The system has since operated with little attention, showing improvement in reliability and a large annual saving in operating and maintenance costs when contrasted with the hydraulic samplers. With the exceptions of the drive motor and magnetic switch of the central timer, and the drive motor for each cutter unit (these being of standard General Electric manufacture), all the electrical equipment was designed by me while plant electrician, and manufactured in the modern and well-equipped shops of the company.

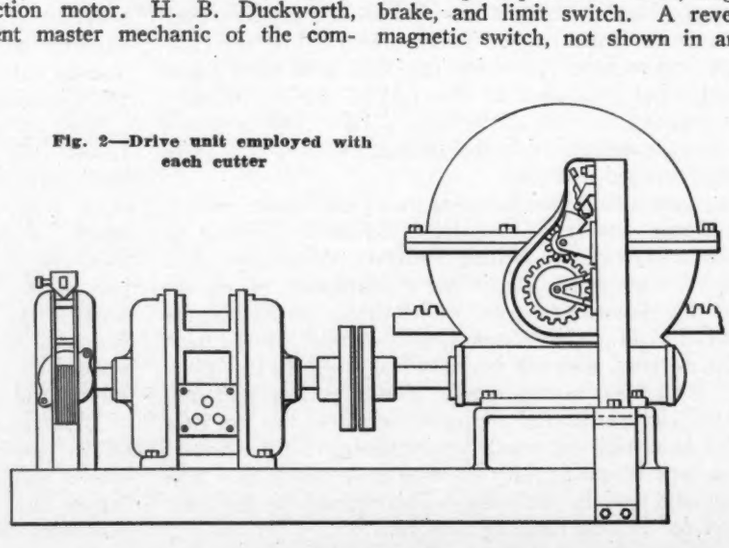
In these samplers the cutter travels horizontally through the stream at uniform speed. Essentially, the system comprises a central timing station, a three-wire control line, and any number of cutter drive units at desired points throughout the plant. The timing station, shown in Fig. 1, is made in the form of a table, with space for a duplicate timer; and it may be placed in any desired location in the plant. The timer disk, shown behind the glass inclosure, Fig. 1, is driven, through an inclosed gear train of high reduction, by a $\frac{1}{8}$-hp. induction motor. H. B. Duckworth, present master mechanic of the company, evolved the details of this reduction gear. Another view of this motor-driven timer is shown in Fig. 4. This form of timer is highly satisfactory and was resorted to after contact-making clocks had proved unreliable. The timer disk revolves at a speed of one revolution in twenty minutes. This gives a time interval of ten minutes between the upper and lower contacts, also clearly shown behind the glass.

Contact at the timer alternately energizes the two single-pole magnetic switches shown at the upper right, Fig. 1, giving, respectively, the forward and reverse strokes of the cutters. Closing of these switches energizes, alternately, each side of the three-wire control line. Thus, all cutters on the system start their stroke at the same instant. As will be explained later, termination of the stroke of each individual cutter is controlled by its own limit switch. This is necessary, because of the varying widths of the streams cut.

The three-wire control line, which radiates from the central timer to every cutter on the system, carries control current only, so that no matter how extensive the plant or how many sampler units may be required, only a line of standard minimum construction size is necessary. Power for the motor of each cutter is taken from the nearest local power circuit.

Fig. 2 shows the drive unit for each cutter. The mechanism, which is assembled as a unit on a steel base, comprises a 2-hp. induction motor, inclosed worm reduction gear, pinion and rack, magnetic brake, and limit switch. A reversing magnetic switch, not shown in any of

Fig. 2—Drive unit employed with each cutter



the illustrations, completes the electrical equipment for each cutter. The maximum power required for any unit was 2 hp., a large double-cutter installation, and all units were standardized with this size of motor, although for some of the smaller cutters, a motor of smaller capacity would be ample. Fig. 3 illustrates the method of attaching the car, from which the cutter is suspended, to the toothed rack of the drive unit. The car travels on a short track directly above the stream to be cut.

The connection diagram, Fig. 5, is easy to follow. The control line is entirely separate from the power circuit. When contact is made at the central timer, one side of the control line is energized, resulting in the closing of one side of each reversing switch. All of the cutters are simultaneously started across the streams in, let us assume, the

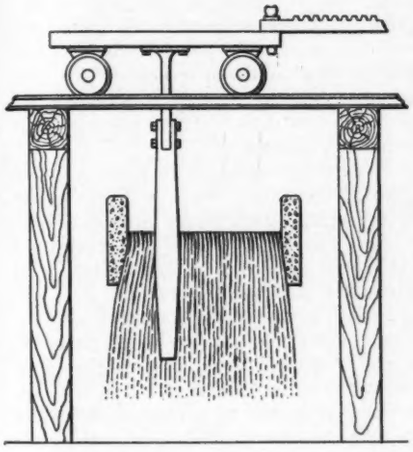


Fig. 3—Method of driving cutter through stream

forward direction. Momentary contact at the timer is necessary only, because, as each reversing switch closes, its own holding circuit then functions to make the switch independent of the control current. This holding circuit includes one contact of the two-contact limit switch (shown as a unit, Fig. 2, with protecting cover cut away) directly coupled to the worm-wheel shaft. This limit switch is of the cam type, with carbon-metal break. A brass pinion and gear, integral with the limit switch, reduces the speed of the cam shaft to the proper value. As each cutter completes its stroke and clears the stream, the holding circuit of its magnetic switch is then opened by the limit switch. The magnetic switch falls open and the magnetic brake prevents further movement, or drift, of the cutter. At the end of ten minutes the cycle of operations is repeated, but this time the cutters travel in the reverse direction across the streams.

While working out the details of the electrical scheme of operation, and while designing the various parts of the electrical equipment, I had in mind three

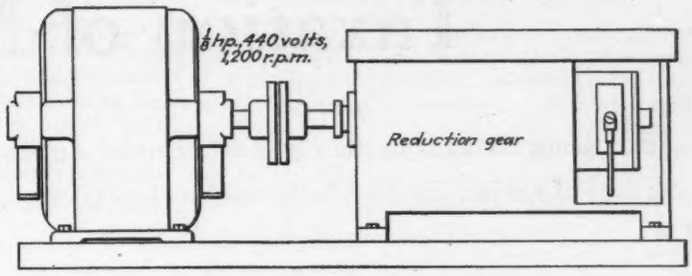


Fig. 4—Motor-driven timer unit

objectives—simplicity of design, maximum reliability in operation, and low operating and maintenance costs. All were attained with a moderate first cost of manufacture and installation. The central timing station is of sturdy construction, with generous capacity of electrical parts, yet inexpensive to manufacture. Reversing switches, limit switches, and magnetic brakes were all designed with the same considerations, and constructed with skill and thoroughness. This procedure was fully justified by the success of the system and its highly satisfactory operation over a long period of time. The system has a high degree of flexibility. The control line carries control current only, so a small initial installation may be added to, almost indefinitely, merely by extending the small control line and installing drive units at desired points. If all the power is distributed through the control station, this would not be possible; unless, indeed, the ultimate installation was anticipated and provided for at the time of the initial installation. Employment of this system, using the small control line, is an important factor in low first cost of the entire installation. The system has a minimum operating cost, both as regards power consumption and wear and tear of operating parts. The machinery operates and power is consumed only during the few seconds while the cutter passes through the stream, so that the actual operating period is but a small fraction of the total time. This is in marked contrast to individual mechanically timed samplers, involving continuous power consumption and wear and tear on the machinery. Cost of electric power for operation is therefore almost negligible, as well as cost of replacements and repairs over a long period of time.

The entire drive unit might readily be provided with an inclosing cover as a protection from dust or water, but this was not deemed necessary. General design of the sampler unit permits location of the drive unit at a point comparatively free from these troubles. The motor, brake, and limit switch are individually protected. The reversing switch may be placed at any convenient favorable point in the vicinity of the drive unit. Both the gear and worm are completely inclosed in a cast-iron housing.

All the equipment was designed to permit rapid and efficient inspection. As will be noted from the illustrations, no delicate gears, worms, screws, levers, cranks, or other such parts are used that might readily cause trouble. The absence of such parts has contributed largely to the success of the installation.

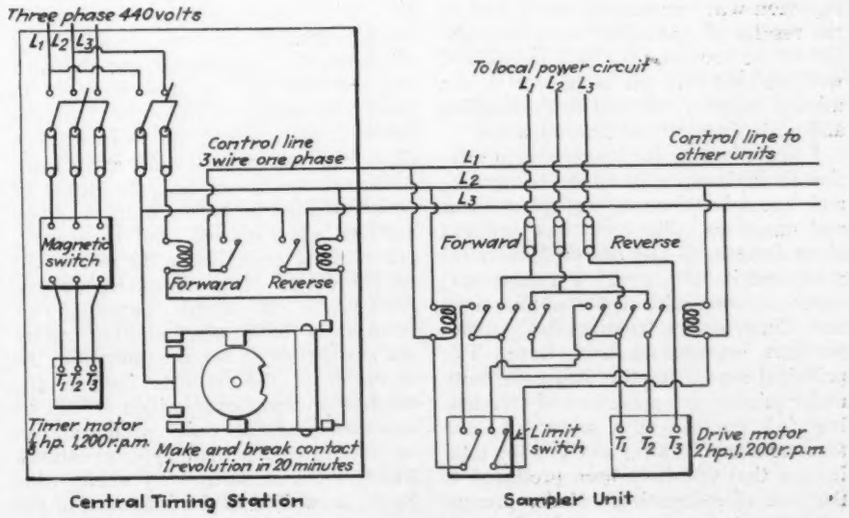


Fig. 5—Wiring diagram

Taxation of Mines

Advocating changes in the tax law, whereby a method of depletion based on a percentage of net income be substituted for the existing discovery-depletion provisions.

W. Earl Greenough

President, Atlas Mining Company, Mullan, Idaho

THE Congressional joint committee on internal revenue taxation has arranged to hold hearings beginning on Dec. 9 in Washington, D. C., to consider the advisability of changes in the present tax law in relation to mining, to permit the calculation of depletion allowance on a basis other than that now provided for. This action has been taken following a report on the depletion aspect of mining taxation, by the committee's own staff, released September, 1929, and generally referred to as the Parker report.

This hearing will deal with a subject of consequence to the mining industry, but few mining companies will be represented or will participate. That they will not be generally represented or heard is because the average mine official regards the subject as too intricate, and of so many ramifications and such consequence, that he does not feel well enough informed to take an active part and permit his thoughts to go on record. Representation of the industry at the hearing will perhaps be through comparatively few men who have had particular experience in taxation matters.

As a result, this committee may consider that its labors are not receiving due attention from mining operators, whereas its activities are being followed with unusual interest throughout the industry. Because of the committee's organization and access to basic data, this governmental body must continue to take the lead in search of a simple tax provision in relation to depletion that will remedy the present intricate method of determination, to the end that depletion will measure its own value by the results of operation throughout the life of the property and will be allowed with certainty to all taxpayers in the mining industry, without discrimination and with simplicity of determination.

Present income-tax procedure, in relation to the taxation of mines, is intricate and excessively costly to government and taxpayer alike. It has brought about inequitable and discriminatory results, and it fails to afford a mine taxpayer the reasonable depletion allowance that Congress, in framing the income-tax laws, intended he should have. The principal reason for this is the difficulty under present tax procedure of forecasting (a) the life of a mine; (b) the total number of units; and (c) the total income that will have been produced at the time of exhaustion. Under present procedure this forecasting of value is a necessary step. This value of a mineral deposit (a capital asset) is intended, under the statute, to be returned to the owner tax exempt by depletion allowance.

Depletion may be stated as the reduction in value of a mineral deposit by the removal of portions of it, until the deposit is exhausted. Depletion attaches to every unit or portion of a deposit, and continues, as long as portions are removed, until the ultimate exhaustion of the deposit. Total depletion, expressed in terms of money, obviously depends on the value of the deposit, and is equal thereto. It is the unsurmountable difficulty in the present tax procedure of forecasting the value of a deposit that brings about the principal and well-founded objections to the functioning of the present income-tax law, with its accompanying discrimination and other evils. This forecasting of value of a deposit is reckoned by what is generally known as the analytic-appraisal method, or present-worth method. Its object is to estimate the present worth of the future expected profits. In other words, the taxpayer must attempt to forecast the ultimate or absolute value of his mineral deposit by this method, and present it to the Bureau's engineers in Washington, D. C., for their audit and revision if their judgment disagrees with that of the taxpayer. In general, the Bureau's engineers do not go into the field to make the appraisal first-hand, but the taxpayer must submit his own valuation data. As the appraisal deals in the main with concealed orebodies, the extent of which will not be known until their last portions are removed, and as the removal of the orebodies in the future will be subject to costs of mining, prices received for the metals, percentage of recovery of the metals, and other factors not susceptible of definite valuation, the appraisal of the ultimate income, the number of years over which it will be received, and the units produced can be nothing more than approximations, which will necessarily vary within wide limits, according to the judgment of the respective valuing engineers.

Following are factors entering into the appraisal, every one of which must be estimated and assumed: (1) The total tons or units in the mineral deposit; (2) the percentage of units that will be recovered from the ore; (3) the prices that will be received for the metals; (4) the cost of production per unit. From these factors the expected income is calculated.

Here it is necessary to make another difficult estimate: What will be the life of the mine—the average annual rate at which the income will be received? After the expected income in terms of annuities has been calculated it is reduced to present-worth value by a discount factor, evolved by H. D. Hoskold. Finally, the estimated cost of the plant necessary in the beneficiation of the orebody is deducted to arrive at the value of the ore only. This final value, divided by the expected number of units to be recovered, determines the value of the unit of depletion. So the depletion sustained during a year is the number of units recovered, multiplied by the value per unit. This is known as the unit depletion method, now used in mine-tax procedure. With the necessity of using all these difficult estimates entailed in the application of this method, the uncertainty of the result must be apparent.

If the necessity for forecasting the ultimate net income from a mineral property was dispensed with, and the property permitted by actual beneficiation to unfold or appraise its own value, measured in net income from year to year until its exhaustion, which in fact it does, we would have for every mine ultimately its absolute or true value. Then, if a fixed percentage of the annual income were allowed as depletion, we would have a percentage of income depletion. Such a deduction for depletion, based upon a percentage of the net income from a property, is known as percentage depletion. Such a depletion would not be based on an undervaluation nor an overvaluation, but upon the precise value of the property.

For every orebody there is only one absolute value, and the amount thereof

and the variable portions of it that will be recovered yearly as net income can never be known until the exhaustion of its profitable life. If every factor in forecasting value by the analytic-appraisal method were 100 per cent correct, the result would give this value, but it would still fall short of forecasting the variable yearly portions in which this value would be won. These variable yearly portions must be known as well, to measure depletion in proportion to value. The unit depletion value evolved from the analytic appraisal assumes the annual profits to be equal—a fallacious assumption. In short, then, why strive to calculate the annual profit in the extraction of an orebody for depletion purpose, when the absolute value of such unfolds throughout the operation of the mine for each taxable year?

Following the enactment of the 1918 law, the Bureau took up the task of valuing every mining property separately as of March 1, 1913, basic date, by the analytic-appraisal method, and thereby determining an individual depletion unit for each. As the Hoskold discount factor for reducing deferred income to present worth increases with each succeeding year that the annuity or deferred income is carried into the future, it cannot be applied for periods greater than 30 to 40 years, because the indicated value tends to become nil. Also, other estimated factors in the analytic-appraisal method become succeedingly more uncertain when carrying the valuation too far into the future.

The Bureau has, in consequence of these and other considerations, valued mines for periods of 30 years or less from the basic date of 1913, although in some cases the period is longer. Seventeen years have now elapsed, and experience shows that many mines have been undervalued, and hence are short of established depletion reserve. Obviously, under this method every mine had a depletion reserve that sufficed for the first year; but, as the industry carried into the future, more and more cases arose of mines that had persisted longer than estimated, and thus have used up all of the depletion reserve originally established, and yet are continuing to produce and still have large and indefinite ore reserves. Continuing this reasoning, by the time 1940 is reached, most of the mines in production then, and whose depletion value was established as of 1913, will be without depletion reserve. Depletion allowance will substantially cease in the future and will not be available to the industry as a whole unless the tax laws are changed. This is a serious situation for the mining industry to be approaching. Although the situation at present affects a minority of mine taxpayers, a solution of the problem cannot be ignored, as it will continue to increase in scope and must ultimately be solved if the intent of the law is to be served in respect to depletion allowance. The sooner it is solved, the sooner equity will be established.

Suggestion is made that a method for percentage depletion be written into the law in lieu of the present discovery-depletion provisions, which have generally failed under difficulties of administration; and that, as fast as all present bases of depletion are used up, all new and subsequent determinations of depletion shall be calculated by a fixed per cent of net income.

Depletion based upon a fixed per cent of net income is expected to have the following principal advantages:

1. Application will be simple. The yearly net income from mining is readily available from each mine operator's books. An operator will be able to compute his tax obligation at once, without delay or uncertainty. The government will be able to audit the account and collect the tax with like expediency. This will result in great economy and simplicity to the taxpayer and the government, compared with the present method.

2. Necessity of forecasting individual valuations, with inherent factors of speculation and uncertainty, will be avoided. It would make the depletion directly related to the absolute value of the ore deposit, attaching to every unit or portion thereof, and continuing as long as portions are removed until the ultimate exhaustion of the deposit. Allowance on any other basis is of limited duration, necessitating readjustment if depletion allowance is to be continued.

3. Inequalities will be greatly reduced. The present system of determining unit depletion value by the analytic-appraisal method for each individual taxpayer, by agreement in conference between the government valuing engineers and those of the taxpayer, when nearly all factors concerning value are a matter of personal judgment, is objectionable. It is a vexatious problem with many debatable factors, the determination of which in the end must result in a valuation for depletion agreement reached through a give-and-take compromise between valuing engineers, each equally sincere in his judgment. Such procedure obviously cannot result in uniform equity. This must necessarily result in inequalities between mine taxpayers within a group producing the same metal, as well as between different groups within the industry. For example, experience may show that, in valuing copper mines, too high a price for copper was assumed, resulting in overvaluation for copper mines—hence, depletion units of too high value; and, with lead mines, too low a price for lead—hence, undervaluation and under-valued depletion units, or vice versa.

4. Discrimination will be materially reduced by providing depletion allowance to those who are now without it, and are unable to obtain it under the application of the present law. It will make depletion available to the small and casual operator, who under present procedure cannot afford to hire talent necessary to set up his case and follow it through the Bureau, as the expense and uncertainty involved do not justify the tax credit by depletion that may be gained. Determination of percentage depletion in all such cases would be simple.

5. With the present depletion basis, the unit having a fixed value, during years of large profit the value of the depletion unit is too small and the taxpayer does not get proportionately enough depletion allowance. Conversely, during years of small profit, the value of the depletion unit is too large, and the taxpayer has too much depletion credit, which may substantially if not entirely eliminate a tax accruing to the government. And in years of no profit the taxpayer will write off depletion value that will be lost to him. This produces instability and wide fluctuations of revenue to the government. Percentage depletion, being proportionate to net income, would stabilize the revenue and be advantageous to both the government and taxpayer alike. This feature is well set forth in the Parker report, which states: "This stabilization of the annual revenue is advantageous to the government and of no disadvantage to the taxpayer."

Percentage depletion is not an untried principle. The method has proved to be practicable in Canada for several years, where the percentage of net income from metal mines allowed as depletion is now fixed at 33⅓ per cent. Our own income-tax laws since 1926, with relation to oil and gas depletion, provide for 27½ per cent of the gross income, with limitations, and appear to be satisfactory to both the government and taxpayers.

The deliberations of the joint committee of Congress on internal revenue taxation should result in improving the income-tax law with respect to depletion in metal mining. In my opinion, attainment of this objective has the most promise in the adoption of depletion allowance based upon a percentage of net income.

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MINE CARS

The rigid-body type requiring a rotary dumper

A. H. Hubbell
Associate Editor

[PART THREE]

RIVALING the side-dumping car in the advantages it offers for handling large tonnages rapidly is the rigid-box-type car. Having no door, latches, or levers of any sort, it is simple in construction and can readily be built so stoutly as to require but little repairs. Its principal disadvantage is that to dump it an additional piece of equipment—namely, a rotary dumper or tipple—is required. Some compensation for this drawback is to be found in the fact that the dumper may be designed to handle several cars at once. The absence of doors, moreover, reduces spillage to that which may be caused by overloading.

Four cars of this general type, though differing in details, are shown in Figs. 11, 12, 13, and 14. Two of them, used under somewhat different conditions, show a certain resemblance in cost of maintenance. This is $0.0075 and $0.01 per ton hauled and trammed for the Engels and Inspiration cars respectively, which will be hereafter described.

Part I of this article dealt with the Granby side-dumping car. Part II with the gable-bottom and rocker-dump types of cars.

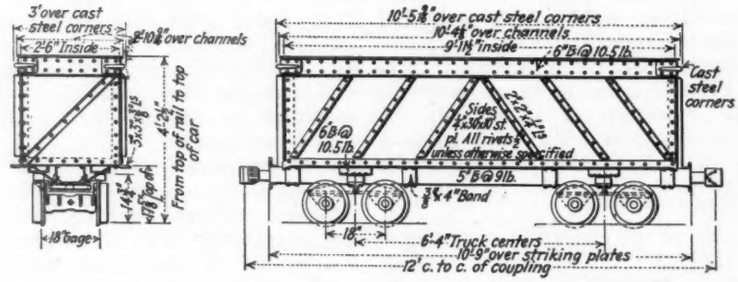

Fig. 12—Park-Utah Consolidated Mines Company, Utah, uses this rigid-body car of unusual dimension

The car used by the Engels Copper Mining Company, Engelmine, Calif. (Fig. 11), is of 96 cu.ft. capacity. The ore handled is a copper sulphide, disseminated in diorite, and is wet and sticky. Broken, it runs 18 cu.ft. per ton, the largest pieces reaching 1 ton in weight. Chute loading is employed, the car weighing 8¼ tons loaded and 3 tons empty. Dumping is effected, of course, by a rotary tipple, as in the other cases where this type of car is used.

Motor haulage is employed, a 7-ton trolley-type locomotive hauling the cars in trains of ten. One hour is required

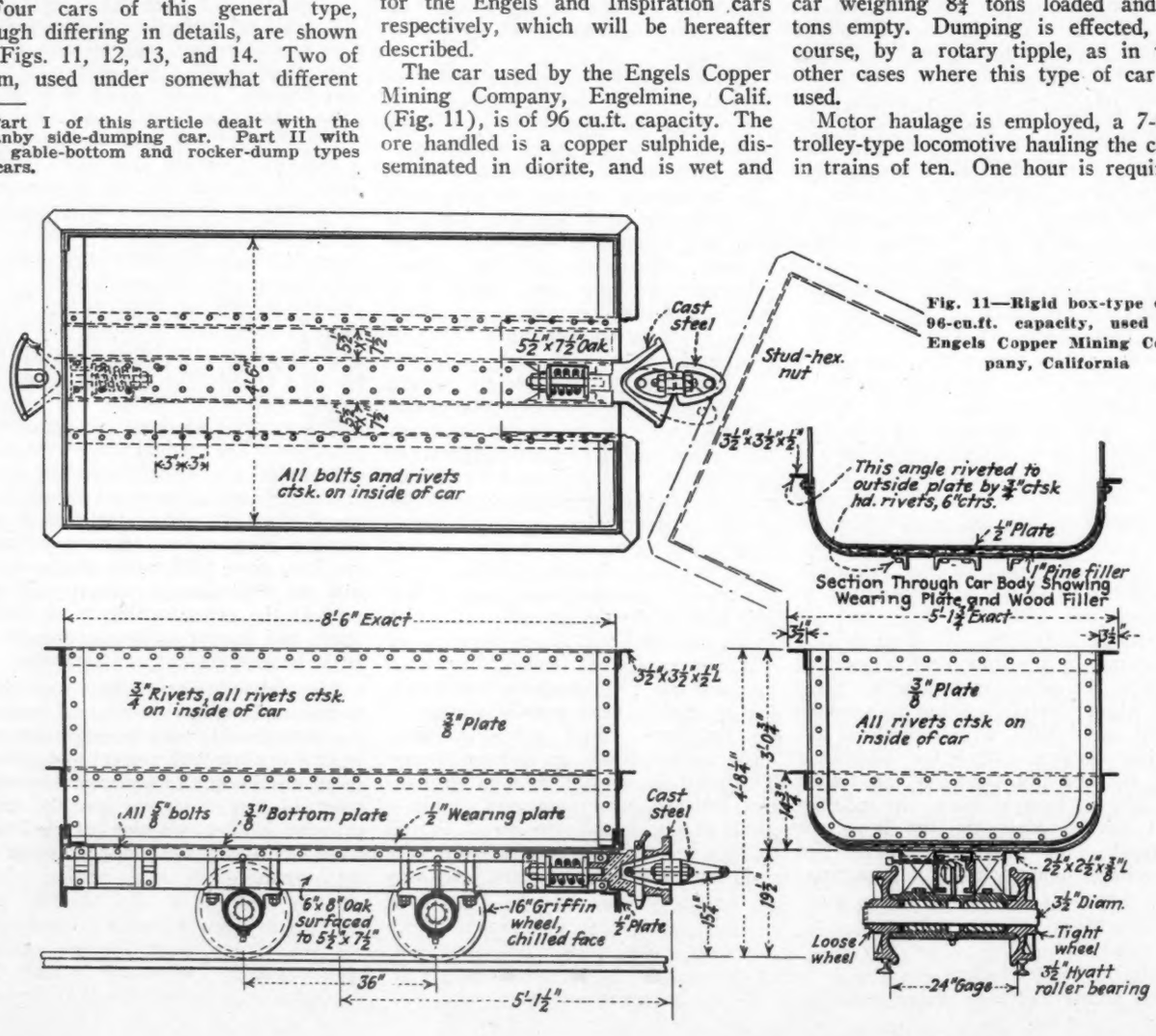

Fig. 11—Rigid box-type car, 96-cu.ft. capacity, used by Engels Copper Mining Company, California

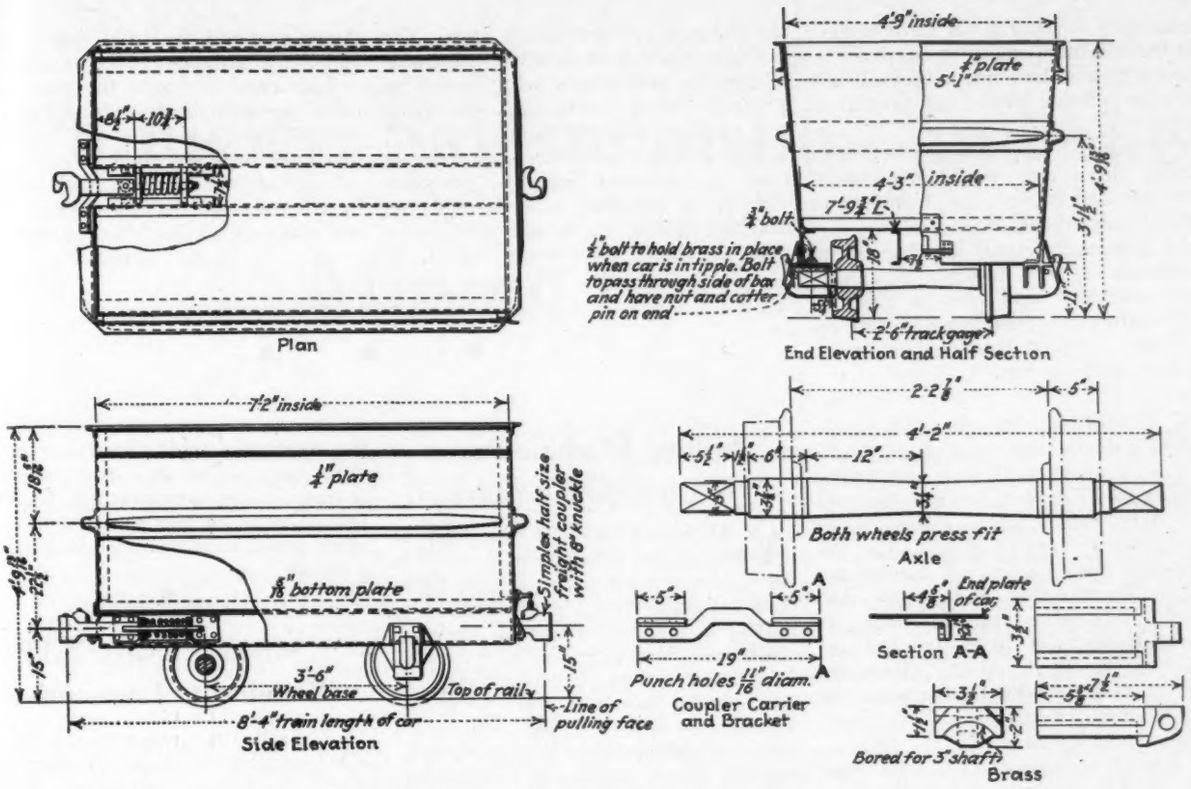

Fig. 13—Five-ton all-steel rigid-body car in service at mine of Inspiration Consolidated Copper Company, Inspiration, Ariz.

for the round trip, the distance averaging 14,000 ft. each way. Track grade averages 0.25 per cent, the maximum being 0.5 per cent in the mine. At the tipple the grade is 2 per cent. In cross-section the haulageway is 8x8 ft. Sixty feet is the minimum radius of curve. The cars have anti-friction roller bearings. The train crew consists of two men. Two to four extra men are required for loading, but dumping is entirely automatic.

The number of man-hours charged per month to car maintenance is 232, the cost of such maintenance, as already given, being approximately $0.0075 per ton hauled and trammed.

Sulphide ore that is only occasionally wet and sticky, and that runs 17 cu.ft. per ton broken, is the material handled by the rigid-body car used by the Park-Utah Consolidated Mines Company, Park City, Utah (Fig. 12). The pieces range in size up to a maximum of 15 in. in diameter, the average diameter being 3 in. The car holds 4,000 lb., its weight empty being 3,450 lb.

These cars, which are equipped with roller bearings, are hauled over a grade of one-quarter of 1 per cent (maximum 1 per cent) in twenty-car trains drawn by two 4-ton trolley locomotives in tandem. The tonnage to be moved on one haulage level is 700 per eight-hour shift. Forty-five minutes on the average is required for a round trip, the average distance hauled being 2 miles each way. The

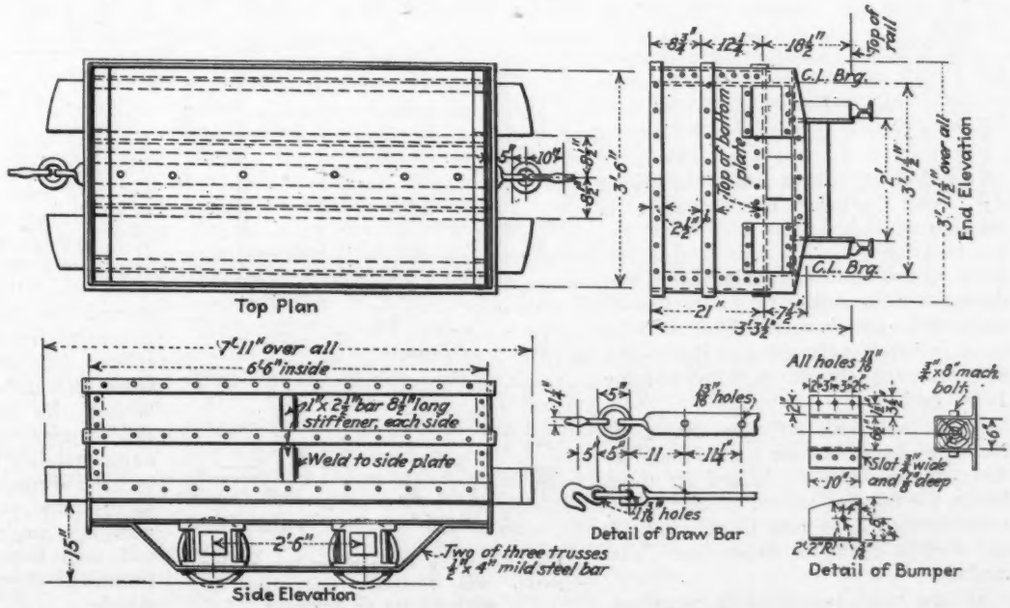

Fig. 14 — Two-ton rigid-body car used by American Zinc Company of Tennessee, Mascot, Tenn.

haulageway is 6½x5 ft. in cross-section and the minimum radius of curve, 20 ft. A train crew of two men is used. While the train is being hauled out, another is loaded.

The monthly labor charge for maintaining these cars is 72 man-hours. Cost per ton hauled and trammed is 0.0078c., remarkably low.

As previously stated in the second installment of this article, the Park-Utah company also uses a 57-cu.ft. gable-bottom car (discussed in that installment) and, on intermediate levels, a 1-ton end-dump car.

IN ADDITION to the 4¾-ton all-steel gable-bottom mine car, shown in Fig. 5 of Part II, the Inspiration Consolidated Copper Company, Inspiration, Ariz., uses a 5-ton all-steel car of the rigid-body type (Fig. 13). The ore handled is the same in each operation—copper disseminated in granite and schist, and neither wet nor sticky. It breaks in pieces of 10 lb. average size and 800 lb., or 5 cu.-ft., maximum. These cars are loaded from chutes, the weight when loaded being 7 tons and, when empty, 2 tons.

Tonnage requirements in this division of the property call for moving 10,000 tons per day on one level. Trains have 20 to 25 cars and are hauled an average distance of 0.8 miles by 8-ton electric (trolley) and 10-ton air locomotives, a round trip taking 40 minutes.

Half of the rigid-box cars have anti-friction bearings and the remainder plain brass bearings. The grade of track is 0.4 per cent on the average and 1 per cent maximum. The haulage way is timbered with sets having a 7-ft. 6-in. cap and 9-ft. posts, battered 2 in. per foot. Sixty feet is the minimum radius of curve.

Five cars are dumped at a time in the tipple. The three-man train crew performs this task without additional help. Extra men are usually required on loading.

Six hundred man-hours are charged per month to car maintenance, the cost of such maintenance being estimated at 1c. per ton hauled and trammed.

AT MASCOT, TENN., the American Zinc Company of Tennessee is using a rigid-body car of 2 tons' capacity (Fig. 14). The ore is zinc sulphide in dolomitic limestone, is dry, and does not cake in the cars. It runs 20 cu.ft. per ton broken. The average piece is 6 to 8 in. in size and the largest approximates 2x2x3 ft., or roughly 1,500 lb.

About one-fifth of the output is loaded by hand-shoveling, the remainder from chutes. Ore is hauled on three levels, the tonnage moved on each being respectively 70, 16, and 14 per cent. A car weighs 3,000 lb. empty and 7,000 loaded.

Where hand tramming is practiced, the distance averages about 75 ft. The average motor haul is 0.5 miles, trains of eight to twelve cars being hauled by a 6-ton trolley locomotive. A round trip requires 20 minutes.

The track grade averages 0.5 per cent, the maximum being 1.5 per cent. The car is equipped with railroad type bearings having an outside solid journal. Crosscuts are driven 7x7 ft. in dimensions and the drifts 8x8 ft. Fifty feet is the minimum radius of curve.

Two men constitute the train crew, extra men being needed for loading but not for dumping. The rotary dumper takes two cars at a time.

Cost of car maintenance per ton hauled and trammed is estimated at 2c., 400 man-hours being charged monthly.

(To be continued)

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Milling Machine Parts With Pipe Threader

AN INNOVATION at the machine shop of the New Cordelia mines of the Calumet and Arizona Mining Company, at Ajo, Ariz., is the method of milling square or hexagonal heads on oiler caps, valve stem slots, and the like, in a pipe-threading machine—costly and time-wasting operations when performed manually or with a shaper. The entire set-up, shown in Fig. 1 of the accompanying sketch, consists of a small cross slide, with a bolted-on jaw vise attached securely to the machine bed, and the cutter arbor, suspended between the die holder and machine head, which act as the arbor support and drive collar, respectively.

The die holder of the machine is equipped with a long, tight-fitting bearing, which insures a smooth running of the arbor and facilitates its centering. To eliminate the adjusting of the cutters and marking of the object to be milled, a special cutter arbor is provided for the various milling operations. When milling hexagonal or square heads, two cutters, spaced according to the required distance across the flats, are employed for this task; and for slots or keyways, the cutter and arbor illustrated in Fig. 2 are used. With this arrangement ten or more valve stem slots can be milled per minute, as compared with three when performing the same operation in a shaper.

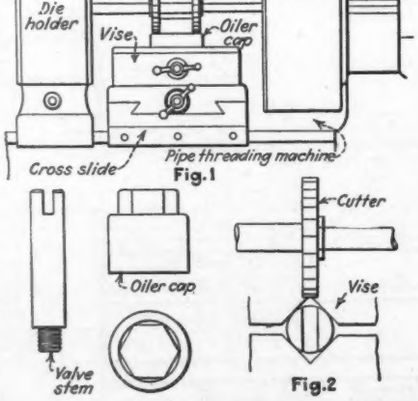

Fig. 1—Set-up of machine for milling parts. Fig. 2—Cutter and arbor for milling slots or keyways

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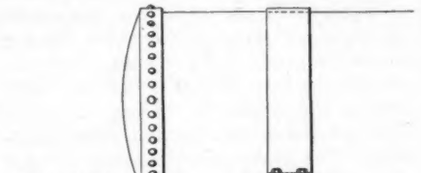
Minor Repairs Add Stability to Locomotive

AT THE Ray mines of the Nevada Consolidated Copper Company, Ray, Ariz., the frequent breaking of locomotive frames was a matter of concern. The locomotives used for underground haulage are driven by compressed air, with the air storage bottle or tank mounted on the frame in the usual way, resting in semi-circular supports, with the tank ends loose and unprotected. With this arrangement, however, excessive shocks cannot be properly cushioned, because the top-heavy or loose mounting of the tank increases the force of the blow instead of neutralizing it, generally resulting in deformed or broken locomotive frames. To overcome this difficulty, additional support to hold the air tank more securely to the locomotive frame, and thus lend extra stability to the entire locomotive, was found necessary. This support was successfully provided by riveting forged plate-iron angle braces to each tank end and then bolting them tightly to the frame, as shown in the accompanying sketch.



Improved method of supporting tank on locomotive frame

Publicity, Salesmanship, and the Mining Industry

INTERNATIONAL dissension, the result of unsolved economic problems, hangs as a threatening cloud over the whole world. In studying the varied discontents, we may note that one of the most acute irritants is failure to heed the repeated demand of economists that legislative barriers to the ready flow of trade between nations be broken down. We find protectionist fervor manifesting itself everywhere, not only between nationals but within empires. Other issues—political, industrial, and commercial—contribute to the disastrous depression in trade. Throughout the United States a fanciful prosperity has been proclaimed from the housetops, but by inexorable law the deadening echo of unsound conditions now reaches our ears. With gluttonous appetite we have gorged at the feast of Belshazzar, oblivious or heedless of the script traced by the invisible hand pointing the inevitable reaction to uncontrolled production. The crash has come. The mineral industry today is in the throes of cyclic inertia; there is a glut of silver; oil fields have been tapped only to be capped; copper, lead, and zinc are almost price-less metals. We cannot dissipate the typhoon of trouble that threatens the world, but we can seek the remedy for our own ills by introspection and self-inventory.

All will acknowledge the brilliancy of American mining technique; practice and process have met with dazzling success. Yet the glare of accomplishments in wholesale production has perhaps blinded us to the fact that mere volume or mass counts for nought. Mass has become master rather than servant. Production gives form utility to our mineral resources, but the progressive increments in value due to time and place utility come from marketing. Profits are not made until goods are sold. The sale of products is the closing chapter of mining, and the price received determines the color of the ink in the balance sheet. Marketing precedes consumption. Price is but the reflection of demand, which itself is mirrored in public interest. The law of price is as variable and uncertain as is that of human psychology. Markets in which price is established are people, not places: they are dynamic, changeful: as volatile as human wants, as mutable as man's desires.

In times of stress, such as at present prevail, in contemplation of prices we ignore consideration of values. This is true whether the price is above or below a normal which can be ascertained by proper evaluation of all economic factors. I am not altogether facetious when I refer to copper, lead, and zinc as being metals without price, for the volume of sales is small. Price implies activity in the market, transactions in exchange. Possibly we should be giving more thought to value rather than to current quotations, for the same people who curtailed production in an effort to maintain copper at 18c. are now restricting output just as much with the metal at 10½c.—an inevitable consequence, perhaps; for eagerness to acquire is animated most when supply is scarce. The money asked for in exchange for goods determines the prudence or imprudence of purchase or sale; nevertheless, all commodities tend to gravitate to a natural price.

It is not my purpose to enter upon an academic exposition of fundamental economic concepts. We should, however, have a sense of values, and the value of metals may be enhanced by the diligent search for new uses and new applications in industry, and by convincing the consuming world of the merit of our good work. We must arouse, stimulate, and maintain a public interest in our wares. Our own confidence in the value and indispensability of the things we produce will be a great motivating force in their distribution. The mining industry must gain adherents and sponsors if its voice is to be heard: it should advertise its achievements. As engineers we have become efficient in technology and routine production, but compared with other business we are deficient in our policies of distribution and sales. The study of marketing has been neglected. The miner's rulership over Nature has become more commanding year by year, but over markets there has not been so far attained a comparable progress.

Particularly in the last decade has metallurgical science expanded the horizon of mining opportunity; but alas the miracle of yesterday becomes the commonplace of today, and established basic principles have been applied to all manner of mineral deposits, precious and base, simple and complex, high grade and low, segregated and disseminated. As a result we find a geographic shift in the center of gravity of production. New processes yield a greater number of end products. That for which we were formerly penalized we are now paid. Output has outrun the established marts of consumption. The evils of over-stimulated growth have been unheeded, plant capacity has exceeded the limits of peak demands, and we have unstabilized prices and a disorganized market. There has been lack of coordination; production is out of control.

The copper market was demoralized in 1921, but the gloom was dispelled by the establishment of record low costs. Efforts were made to control production intelligently to keep step with consumption. All went well until early last year, when the price was boosted to an unwarranted high of 24c. to settle back to 18c., an inflated and altogether fictitious price. Not two years ago, a member of the Copper and Brass Association claimed[1] that the world would demand all the copper North and South America could produce and would absorb the output of South Africa in the next five years. He said, "There is no single cloud in sight to indicate anything but prosperity in store for the copper industry." "The sales value of copper and its alloys is firmly established for many purposes." It is difficult to reconcile such enthusiasm with the studied proposal of Past-President Smith, who about that time appointed a technical committee of the A.I.M.E. on production control "to throw some light if possible on the pathway toward industrial self-coordination." I venture the statement that had the market price of the red metal been set at 15c. in 1928, today's débâcle would not have occurred; certainly it would not be so serious.

Abstract of address by Dean Frank H. Probert, College of Mining, University of California, before the San Francisco section of the A.I.M.E., Oct. 2, 1930.

[1] *Mining and Metallurgy*, Vol. 9, p. 543.

There has been no unity of purpose between individualistic producers. Keen competition has stimulated output and flooded the market. Both high-cost and low-cost producers took advantage of prevailing prices, whereas had a natural price been recognized, only the fittest would have survived and price would have been adjusted to the true requirements of demand.

The larger copper mines of the country are working at less than 40 per cent of capacity; many properties have shut down. The curtailment of output is only abortive, and restrictive measures are almost negative in their influence. Idle machinery, heavy maintenance costs, disorganization of staffs, unemployment, and other attendant ills are economic calamities. Real stability is always in the wise conduct of business. We cannot hope for relief through artificial channels. Tariffs won't help, for we are already dominant in world production of many minerals. We cannot absorb our own output. Foreign trade must be fostered.

Mining is not an infant industry in the United States. It has reached imposing stature. In fact, it is awkward in its overgrowth. Moreover, to impose restrictions on trade is but to invite retaliation in kind. Already threats have become actualities. "America is too rich to be loved. She is well enough off to be envied. The attitude of the world toward her will be largely influenced by her spirit," said Mr. Owen D. Young last March. We cannot hope to enlist the sympathy of Congress to guarantee the disposal of mine products, even though that august body has so devoutly espoused the cause of agriculture.

We are confronted with much business but no buyers; and the fact is not just as reason would argue it, nor is it what impulse and emotional conviction would declare. We of the mining fraternity must have increasing knowledge of how, when, what, and where to sell.

Salesmanship requires intimate knowledge of goods, of people, and of their conscious or created desires. To anticipate the scope and condition of the market is of importance: there is need of consumption statistics, anent which Secretary Bain has written: "No better move could be made by consumers of metal than to join heartily in a general move to let daylight penetrate into their part of the house." Co-operation connotes constructive vision, but as yet it seems that the light does not shine that men may see. To illustrate: Electrical supplies, whether for use or luxury, are no cheaper today than when copper sold at the high price last year. Judged by prevailing prices of his fabricated wares, the silversmith is apparently unmindful that silver is offered for 40c. an ounce. Sterling silver is cheap, yet we see none of it at Woolworth's or Kresge's. Surely, in the economic problems of manufacture and distribution we could inject a little engineering common sense. In the last fifteen years, in face of increased wages, higher supply costs, and 300 per cent higher taxes, unit costs have been lowered. The price of copper has fallen as the potential power to produce has expanded, but have copper commodities been lowered in price? Very little. Between original producer and ultimate consumer the increment to value supposedly for distribution is disproportionate to other costs.

Carelessness frequently accompanies and confusion often follows the usage of the terms "production" and "consumption." The statistician must make clear his meaning, particularly so in consumption data, wherein delivery of standard material is implied rather than quantities actually absorbed in fabrication; the substance has not yet reached the ultimate consumer.

Integration of industry has segregated control, and the last decade has seen many noted examples of economies and broadened activity flowing from this larger business structure. Thus Anaconda Copper, with the slogan "from mine to consumer," and all marketed material trademarked with a spearhead, has successfully undertaken the promotion of direct sales. Phelps Dodge, by the acquisition of National Electric Products Corporation, evidently anticipates the same policy. Other large producers may follow suit.

An awakening to the importance of intelligent marketing was noted in 1919, when non-ferrous metal producers subscribed to the American Bureau of Metal Statistics. Ready information is available concerning foreign and domestic trade, mine, smelter, and refinery activities, and surplus stock. This was followed in 1923 by the Copper and Brass Research Association, which, by research and advertising, seeks to widen the use of metals. Copper Exporters was formed in 1926 to centralize the sale of copper abroad: in 1927, the Copper Institute, to disseminate intimate information as to price, sales, quantities, and costs to the producers. American Zinc Institute is following the policies of the copper groups, by improved merchandising and widespread advertising. The Silver Producers' Association is similarly organized. The trade promotion series of publications of the Bureau of Foreign and Domestic Commerce, Minerals Division, are exceedingly helpful in an understanding of supply and demand, as are the so-called economic papers of the U. S. Bureau of Mines. The technical magazines are devoting more and more space to mineral marketing—throwing light on hitherto obscure aspects of the industry, thus enabling men to see our good works. This recital of activity in sales promotion, imposing as it is, nevertheless indicates there is yet much to be done. If we leave all to the manufacturers, we are still subject to their whims, fears, and fancies. We must appeal to the people, for in the last analysis they are the buyers.

The buyer is as a rule apathetic. He purchases usually under the urge of want rather than from lust of possession. He must be convinced as to the value of the goods. It requires aggression on the part of the salesman, assurance and self-assertiveness born of knowledge as to the merit and purpose of the thing offered. Variety and novelty lend spice to the situation. Have we even touched the possibilities of new products and new applications? There is a thrill in spanning the octave "twixt the dream and deed"; hence the coming vogue of industrial research. Under the stimulus of ideas of the scientists, truly remarkable results have been accomplished. Capital may reap the harvest of dividends. Labor may be requisite, but it is the mind that performs the miracle. For advancement we must utilize the creative power of research if we are to avoid its alternatives—retrogression or stagnation. Research offers better protection than any subsidy, duty, or tariff.

The world is ruled by ideas which possess the power of penetration and lodgment, and the weight of the individual citizen in the body politic is dependent upon the degree of receptivity to rays of intellectual illumination. Quoting Dr. Julius Klein, of the U. S. Department of Commerce: "Advertising is one of the most potent of business accelerators." It inspires confidence.

I think we are all too prone to hide our light under a bushel, to live within ourselves, to horde rather than distribute information. Our accomplishments are matters of public concern inseparably related to national progress and international prosperity and peace. Knowledge should flow freely between responsive minds. It matters little how this is done, but done it must be. There must be sales appeal. In these days of intensive reading and prolific writing, publicity can play a conspicuous rôle in sales promotion. "Spear-head" brand products of Anaconda Copper are intensively and extensively advertised, in architectural journals, plumbers' guides, *The House Beautiful, Ladies' Home Journal,* and many other magazines.

Through the medium of leaflets, booklets, window displays, blotters, trade conventions, motion-picture films, and other means, the volume of business in brass pipe has increased seventeen times in eight years. The progressive company has good goods for sale and aggressive salesmen.

Advertising inspires confidence: it creates good will, with which business flourishes; and without which it wilts. An advertising message must strike the public consciousness unremittingly, time and time again. It has a cumulative effect; it is inherently constructive; it pays.

Trend of Ore Hunting in the United States

Augustus Locke
San Francisco, Calif.
Paul Billingsley
Salt Lake City, Utah

THE *new art, concerned with more remote ore, emphasizes not veins and faults only, but various marginal phenomena of mineral areas. Also, it seeks to build up such a broad and complete picture that new centers of ore deposition may be indicated by the general relationships, though direct indication by outcrop or other means be totally lacking.*

DISCOVERIES of primary ore were made in outcrops by an old ore-hunting art. The continuing ore supply has come from extensions deepened by that same art 50 to 100 ft. each year. The present trend, set by the rising cost of these extensions, is toward the discovery of ore without outcrops. Hunting for such ore constitutes a new art. This paper discusses the change of procedure and illustrates the kinds of such ore which experience shows the new art is able to discover efficiently.

Early American ore discovery was an incident of land settlement. In effect, the raw mineral passed from the hand of the Indian, who suspected nothing, to a crowd of adventurers already experienced in its use. Who composed that crowd counted for little; for collectively it could project into the wilderness the ray of Old World life, and repeated attempts by plain men made up for the defects of individual skill. Mere common energy secured the prospecting of any ground which promised to yield metal. Apparently carried on the shoulders of historic personages, discovery was actually a trend which no one, however powerful, could resist.

Along this trend have grown the primary discoveries of the United States, to supply a metal consumption which already, in the twentieth century, has exceeded that of all preceding time. Not even yet has a science of occurrence taken command of ore hunting. The geologist, it is true, has systematized stratigraphy and structure and, when petitioned for advice, has guided projections and tracked separated segments. But he has worked chiefly underground, where he must depend on scattered fragments. The surface he has radically neglected. He has made no comprehensive search for structures warranting primary, deep exploration. It is not the geologist who has furnished the energy and led the way, but the miner-financier, who, with all his thumb-rule illusions, is moved by the single idea of putting himself on ore and following it wherever it may lead him.

The traditional art still controls. This art owes its use to its simplicity. To sink on an outcrop, to cut up the ground, and follow extensions by miner's skill is a procedure understood by entire mining communities. To reason out detached, hidden ore from structure, on the other hand, is an intellectual experiment whose hazards are little understood, even by those best qualified to know. Whatever the means employed, repeated forays into the ground have attained sufficient success to remove the need for leadership by refined skill in ore hunting.

The Old Art Under Present Conditions—How, then, does the old art serve under present conditions? As would be expected, it is applied within generalized pictures of structure revised each time the ground is cut on a deeper level. The history of development is marked with structural surprises which later knowledge explains quite simply. Altogether, the program, which has worked admirably in shallow ground and in the rich environs of known ore, seems now, in the deepening and more costly enterprise, increasingly ill-planned. While the mechanical engineering of excavation has continually improved, the control of the excavation has been less prompt to utilize the advances of the times; too often, it either gropes in the darkness, step by step and level by level, or it plunges in with the old-time energy but with no understanding of the reduced percentage of successes as the old ore extensions give out in depth. In only a few districts, among the several score which have yielded important production, has the structure become known in clear-cut detail.

The old art has ceased to make primary discoveries. We are supplying the increasing flood of metal by mining extensions 50 to 100 ft. deeper each year, in competition with flush production from new discovery in other countries. The cream is skimmed. How many accidental bonanzas will come to save old mines from death, we cannot say. But we can say that the cost of discovery trends steadily upward, and that an increasing number of decadent districts promise to wait helpless until more practical ideas on the finding of detached ore can be supplied.

To summarize: The old mines, discovered at their outcrops, are gradually failing with depth. To find new mines, by means of valuable surface ore, is almost hopeless after two generations of continuous intensive prospecting. A new procedure is required whereby orebodies without outcrops may be successfully found.

The New Ore-Hunting Art: Ore Without Outcrops—There is, in brief, a trend toward systematic hunting for ore which has no outcrops. This is something different and new. It requires a skill in the solid geometry of structure, and, above all, an appreciation of the dim but vitally significant effects which are grouped about a hidden orebody. Like various other arts of industry, it lies, definitely, beyond the strategy of unaided common sense, in the realm of technical expertness. It looks forward to primary explorations, even 2,000 ft. deep, for ore wholly beyond reach of past devices.

The new art differs from the old in two respects. First, since it is concerned with more remote ore, it observes and emphasizes, not veins and faults only, but also the marginal phenomena of mineral areas. Second, it attempts to build up such a broad and complete picture that new centers of ore deposition may be indicated by the general relationships, though direct indication by outcrop or other means may be totally lacking. Obviously, these objectives place an increased burden upon the geologic eye and the geologic imagination, a burden which calls for the aid of such special tools as the physicist and the chemist are beginning to provide.

In a few great mining districts, among which Butte is notable, the intensified methods to which reference has been made are being developed, and ore without outcrops is being found. It is upon the experience in these districts that we have based our ideas as to the nature of the deep ores which the new art seeks for and as to its effectiveness in their discovery.

Present Emphasis in Use: The

Mechanics of Ore Conduits—The new art is specifically concerned with factors which are determinable. The place and means of origin and the density and composition of the ore-bearing fluids are left resting in the background of thought. Furthermore, from the legion of particulars which can be seen by the eye of the observer, a special selection is made of those known to govern ore.

Recent deep developments have demonstrated that the fundamental fact in a mining district is not its rock formations but its conduits for ore-fluids, passing through the rocks from a high-pressure source toward a low-pressure terminus. Though the geologist grants theoretical exceptions, such as orebodies made by gravity concentration, in experience the conduit has proved the practical key to hidden ore. These conduits ultimately found a surface outlet. Here again the geologist grants exceptions, but believes them practically unimportant. In other words, when he is following a conduit which has come up from below, he is taught by experience to believe that, during mineralization, it continued unclogged to the surface then existing, where it issued, making a fumerole or thermal spring and depositing surface sinters. He expects, therefore, the continuation of the conduit toward that surface, whatever the barriers and whatever the devious paths which it must follow and the splittings and rejunctions which it must undergo.

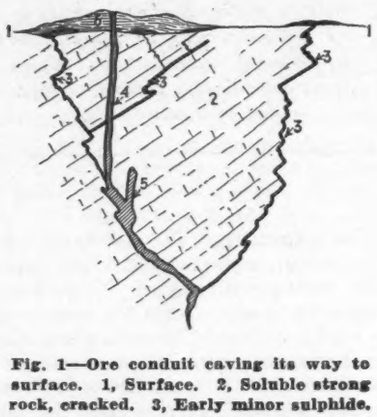


Fig. 1—Ore conduit caving its way to surface. 1, Surface. 2, Soluble strong rock, cracked. 3, Early minor sulphide. 4, Late major sulphide in short-cut conduit. 5, Short-cut conduit, failing to reach surface. 6, Surface sinter.

Along the conduit, the places of abundant ore are conspicuously the places where the conditions of flow were changed. There are, of course, complicating factors, such as reaction with wall rock and drop in temperature, causing supersaturation and precipitation. But these remain subordinate to and principally controlled by the nature of the conduit itself. If that be large, open, and continuous, it may carry hot fluid for miles with small drop in temperature or pressure, and hence, either not precipitating its ore, or forming it as an extensive ore pipe. If, on the other hand, it disperses suddenly through a cracked and porous body of rock, as in a disseminated copper deposit, it cools and drops its load of metal within a journey of a few tens or a few hundreds of feet.

Any condition whatever, affecting the freedom of flow, affects the quantity, shape, and distribution of the ore. Strong walls, inert in the passing fluids; strong soluble walls, in which the conduit progressively enlarges and grows freer; weak soluble walls, cracking and collapsing into solution vugs, admitting mineralization into new cracks, and thus altering the original channel from a crack to a rubble-filled conduit; walls altering to clay which stops the conduit and pushes it constantly out into new ground; strong soluble rock roofed by shale, in which the conduit becomes sealed, and under which it turns flat—in each case the conduit will have a special shape and a special control of the ore which follows it. Whatever the wall rock, it will display an alteration halo which is derived from the exhalations passing along the conduit. This halo will be controlled in detail by rock structures, and it will ordinarily contain within itself the orebodies.

The present trend in ore-hunting geology, therefore, is twofold. It is vitally concerned with the mechanics of conduits, the primary sources of ores, and it is profoundly impressed with the significance of alteration halos around those conduits. In the mass of rocks, for example, lies a sill of monzonite: the important feature of this sill is its effect on the conduit. Does it shatter, making leaky walls? Does it stand rigid, holding spaces open for vuggy ore to form in? Does it alter, crumble and cave? To name the rocks and picture their occurrence is no more than the preliminary step; only by defining them as structural materials do we give them meaning for finding ore. A shale bed and a softened porphyry have identical effects, whereas two beds of limestone, one thin-layered, the other massive, differ strikingly. It is these resemblances and differences which make a structure model capable of finding ore[1]. Nor in this model must the openings and closings of conduits during mineralization be for a moment forgotten. What is the effect of a lava flow or mud flow covering the orifice? What if the fluids, meandering through a network of cracks, are captured by a cut-off conduit caved through to the surface? With the pressure reduced, the seepage grows to a flood and the previously existing system of channels thenceforward ceases to function. Does the new Cananea bonanza pipe correspond to such a cut-off? And as to "pipes" in general, are they root feeders into the main mineralization or upward outlets from it? The answer is not yet complete, but the trend of present ore-hunting is to put through the studies which will make it so.

[1]Knopf's Mother Lode and Nolan's Tonopah work illustrate the mechanical emphasis.

Such questions point out the special nature of problems which the geologist is being urged to solve. He traces the channelways backward toward the source and forward toward the surface orifice. In doing this, he finds the alteration halos the most valuable guides. The habits of occurrence thus established, he projects into hidden country with whatever art he may possess. We may say that this art takes only a single step beyond that of the past—namely, instead of following ore only, it follows the channelways, identifies them in barren intervals, and infers their presence from other geologic facts, when they are hidden. It establishes the large geologic frame in which not only new ore, but also new channelways, may be found.

This step carries us beyond the details of individual mines, into larger questions of district localization. The trend is to seek in each district a major, localizing break. This break is found to persist geographically through and beyond the district; if an individual fault does not persist, parallel faults or folds do. It is found, also, to persist historically; it made a locus of movement earlier than intrusion; it made a locus of intrusion; it made a locus of ore; and it continued to function later so as to cut post-ore rocks. Indeed, this major break tends, with further study, to make a boundary between crustal blocks sometimes shaped out even as far back as Pre-Cambrian time. Evidently, it strikes into deep, hot zones, far below those reached by mining. The ore, then, becomes an incident in a long-continued history of crustal adjustment,

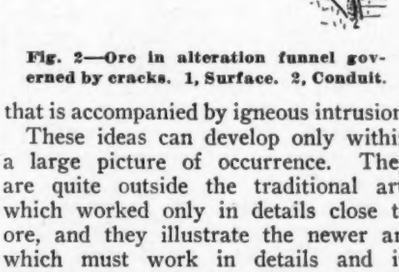


Fig. 2—Ore in alteration funnel governed by cracks. 1, Surface. 2, Conduit.

that is accompanied by igneous intrusion.

These ideas can develop only within a large picture of occurrence. They are quite outside the traditional art, which worked only in details close to ore, and they illustrate the newer art which must work in details and in generals as well. A striking example in this connection is Butler's recent paper on the Colorado Plateau, which, by the compilation of the known structures of five states, shows that plateau, 500 miles in diameter, as a crustal unit carrying ore districts sharply concentrated around its boundary. Following this discovery, mapping now suggests that the individual ore districts sit grouped around satellitic blocks, whose boundaries can be so traced as to make a large framework of intercommunicating conduits.

(To be concluded)

Copper Ores of Northern Rhodesia

PROFESSOR Alan A. Bateman, of Yale, writing on "The Ores of the Northern Rhodesian Copper Belt" in *Economic Geology* reaches the following conclusions:

The Northern Rhodesian copper belt will constitute the greatest individual copper mining center of the world. More than 300,000,000 tons of over 3¼ per cent copper have already been developed. In four or five years the region should be producing 400,000,000 lbs. of copper; in ten to twelve years a production of over 1,000,000,000 lbs. is possible. The ore reserves may reach from 500,000,000 to 1,000,000,000 tons. The important mines are the Roan Antelope, N'Kana, Mufulira, N'Changa, N'Changa W. Extension, Chambishi, Bwana M'Kubwa, and the Baluba and Chingola prospects.

Geographically, the region is a slightly dissected peneplain uplifted to around 4,000 ft. The surface is flattish and bush-covered. Outcrops are few. The climate is two-seasonal—rainy and dry; the elevation offsets the low latitude; it is a "White man's country."

The rocks consist of an old pre-mineral basement complex uncomfortably overlain by the ore-containing Roan series, consisting of 3,000-4,000 ft. of clastic sediments presumably of continental origin and of late Pre-Cambrian age. Above this is 14,000 to 15,000 ft. of generally similar sediments, all of which may be of Pre-Cambrian age. These beds contain 500 ft. of conglomerate considered to be of glacio-fluvial origin and probably contemporaneous in age with the "Tillite" of the Katanga. The Roan series is intruded by younger granites and basic intrusives. Probably the former are the source of the copper. The sediments have been folded into simple pitching folds of northwesterly trend. Erosion has cut away the anticlines; parts of the synclines remain. The beds form V-shaped outcrops.

The ore deposits consist of one or more beds of the Roan series that have been fairly uniformly metallized with minute specks of copper sulphides that average from 0.2 to 0.75 mm. in diameter and are as small as 0.0001 mm. Usually, the ore beds range in thickness from 25 to over 100 ft. They occur in the synclines, and dip from 20 to 90 deg. Their length is remarkable; the Roan Antelope ore bed has been developed around the nose of a plunging syncline for 28,000 ft. and traced by sparse drill holes for an additional 22,000 ft. Their depth is unknown; the deepest drill hole in ore is 2,562 ft.

Northern Rhodesian ores are largely sulphide; the N'Changa and West Extension ore is mostly oxidized; the Bwana M'Kubwa is all oxidized. Sparse and erratic deep oxidation occurs in all the mines. The oxidation extends hundreds of feet below the water level and the deep oxidation probably took place during a preceding desert climate. Outcroppings are largely oxidized to water level. The oxidized croppings may be leached or contain oxidized copper minerals. They are susceptible of interpretation as to their previous sulphide content.

The mineralogy of the sulphide ores is simple. Chalcocite is the most important sulphide, followed by bornite and chalcopyrite. Linnaeite (a rare cobalt sulphide) is not uncommon and pyrite is rare. There are traces of covellite and sphalerite. Some quartz and carbonate and a little tourmaline have been introduced. The chief gangue is the inclosing rock, which consists of slightly metamorphosed argillite, arkose, feldspathic quartzites, and graywacke. These rocks have undergone some alteration as a result of the metallization.

Eight types of chalcocite intergrowths are described and discussed. Of these, two are characteristic of supergene (secondary) replacement by chalcocite; six suggest a hypogene (primary) origin of the chalcocite; three of these suggest contemporaneity between chalcocite and bornite. The conclusion is that the chalcocite is in part hypogene and in part supergene. The chalcocite is all orthorhombic, but some of it indicates an isometric ancestry, which means it was formed originally above 91 deg. C. Part of it may have been formed above 200 deg. C.

The paragenesis is pyrite, linnaeite, chalcopyrite, chalcopyrite and bornite, bornite, bornite and hypogene chalcocite, hypogene chalcocite, supergene chalcocite, and oxidation products.

Some supergene sulphide enrichment of (as yet) indeterminate amount has taken place. No well-defined supergene chalcocite zone has so far been delimited. The diminution in copper tenor below the supergene sulphide enrichment zone will in general probably prove small.

The deposits are of epigenetic origin. Apparently, the sulphides have been introduced subsequently to the consolidation and folding of the rocks; they have clearly replaced the rock silicates. The probable source of the metals was the granite magma chamber.

Localization of the ore minerals in the sediments was probably due to the superior permeability of the ore beds. The larger localization in certain parts of the region is thought to be due to the proximity of granitic intrusions. It is set forth that where cupolas of granite magma, into the top of which the mineralizers accumulated, ate their way into synclines and intersected permeable beds, the metallizing solutions escaped along such beds in the direction at least pressure. Then when suitable conditions obtained, deposition by replacement took place. Fissures may also have tapped off the solutions directly from the magma cupolas, or diverted them into other beds.

The Rhodesian copper belt, together with the adjacent Katanga copper region, constitutes a great metallogenetic province of copper mineralization. They are linked together by many similar features of geology and ores, and the common occurrence in each of the rare mineral linnaeite establishes a kinship between them.

■ ■ ■

Underground Haulage in Metal Mines

Diversity of opinion exists as to the relative merits of the storage-battery locomotive and the trolley locomotive. Mr. Newton writes from an extensive experience with both systems, and his comments and conclusions are presented with the idea of stimulating discussion of the features and advantages of the two methods of electrical underground haulage

George C. Newton

Iron Mountain, Mich.

IN RECENT YEARS the mining industry has expended large sums of money, and has made noteworthy efforts, to prevent accidents. During the same period most metal mines have continued to use the trolley system of underground haulage; and, in many recently opened mines, new installations of this system have been made. As applied to underground metal mines, the two policies would seem incompatible, and their adoption is an example of inconsistency. The reason for this probably lies in the fact that the trolley system of underground mine haulage, developed first, has been in use much longer and to a far wider extent than the storage-battery system. The impression has been general that the storage-battery system involves considerably higher tramming cost, and that the trolley system is simpler and more sturdy in operation. These factors in favor of the trolley system of haulage possibly did exist during the earlier stages of its development, but changes and improvements during the past ten years have, I believe, offset these factors. The difference in cost between one system and the other, taking into account all charges, has become negligible. The choice is now between the respective advantages of the two systems. For haulage per ton, the cost with either is about the same. The dependability will certainly be as great with storage-battery locomotives as with trolley locomotives, although such a comparison would be unfair to the storage-battery locomotive.

Important developments in recent years of marked advantage to the storage-battery locomotive comprise (1) the improvements made in and decrease in cost of storage batteries; (2) ability to render longer service; and (3) the development of quick and simple battery-box transfer systems. A lead-cell storage battery of reliable make will ordinarily give at least four years' service; most batteries will give about five years' life. A system of quick battery transfer permits keeping in reserve an extra storage-battery unit, including battery box fully charged at all times. Thus a locomotive, in case its battery becomes exhausted during a working shift, can come to the charging station for a fully charged battery, the total time required being less than ten minutes. Storage-battery units of smaller kilowatt-hour capacity can be used with economy and advantage. In fact, for a given investment, much better serviceability can be secured with more battery units of somewhat smaller capacity than with larger battery capacities and only sufficient units to correspond to the number of locomotives. The larger number of battery units also gives greater flexibility in charging. The full advantage of booster charging is perhaps not always appreciated. For instance, during a one-hour idle period between shifts, by giving it a booster charge, approximately 25 per cent of the full rated capacity can be returned to the battery, assuming that it was half discharged at the beginning of the booster charge period. Such use of power during the off-shift period, when the mine electrical load is low, improves the load factor.

Certain haulage conditions would almost require the choice of one system without consideration of the other. For instance, for long hauls with stiff grades against the load, the trolley locomotive would be best adapted. On the other hand, if the fire hazard were great, or if haulage drifts are difficult to maintain, or if mine safety regulations are unusually severe, storage-battery locomotive equipment should be chosen. However, the grades are not severe in most underground metal mines. They are generally in favor of the load, because mine drainage usually follows the main haulage drifts. Also, in most mines, the fire hazard is not excessive, and the main haulage drifts are generally of a fairly permanent nature.

The statement that the difference in cost for tramming ore with one system as compared to the other is negligible may be questioned; the trolley system may seem to show advantage over the storage-battery system in this respect. I am accordingly considering this matter in detail, first as to the original cost of the equipment, including installation, and, second, as to the relative operating costs. I believe that a careful consideration of the various cost items will show little more than a negligible difference.

Table I shows a comparison of the various items of cost.

Item 1—The cost of a trolley locomotive, complete, will be about the same

Table I—Comparative Items of Cost

Trolley System		Storage-Battery System
Investment and Original Installation		
Item 1: Cost of trolley locomotive complete	=	Cost of storage-battery locomotive chassis complete
Item 2: No corresponding item		Cost of storage battery, battery box, and transfer rack
Item 3: Cost of trolley wire system, rail bonding, trolley wire guards		No corresponding item
Item 4: Cost of motor-generator set, switchboard, and conductors down shaft	>	Cost of motor-generator set, switchboards and charging equipment
Operating Costs		
Item 5: Locomotive operating labor	=	Locomotive operating labor
Item 6: Locomotive repairs and supplies	>	Locomotive and battery repairs, labor, and supplies
Item 7: No corresponding item		Battery-charging labor
Item 8: Trolley system extensions. Maintenance and repairs. Labor and supplies		No corresponding item
Item 9: Cost of power	>	Cost of power
Item 10: Cost of electrical demand load	>	Cost of electrical demand load

as the cost of a storage-battery locomotive chassis, complete, of equipment size.

Item 2—The cost of the storage battery and battery box has no corresponding item under the trolley system.

Item 3—The cost of the original trolley-wire installation, complete, including rail bonding and all trolley wire guards, has no corresponding item under the storage-battery system.

Item 4—On account of the much larger size required and because the motor-generator set for the trolley system is usually installed on the surface, requiring two conductors of large ampere capacity, extending to and down the shaft, the cost of the motor-generator set, with necessary switchboard and conductors down the shaft, for trolley system of haulage, is much greater than the cost of the smaller-size motor-generator set switchboard and charging equipment required for the storage-battery system. The cost of these items for the trolley system would be about twice that for the storage-battery system.

Item 5—Under operating cost, the operating labor for the locomotives would be the same for either system.

Item 6—Locomotive repairs, including supplies and labor, are much greater for the trolley locomotive than for the storage-battery locomotive. This is due primarily to the fact that the latter operates under a controlled or limited power supply and at both a lower and more uniform voltage than does the trolley locomotive. The operator of a trolley locomotive is able and generally does throw excessive amounts of electrical current through the locomotive armatures under certain conditions, resulting in armature breakdowns. These same conditions of excessive armature current also result or tend to result in somewhat greater repair costs for parts of the locomotive such as the controller and other mechanical features. In contrast to this, and to the many trolley-locomotive armature repairs, are the exceedingly few repairs required for the storage-battery locomotive and batteries. At one mine, nearly 1,000,000 tons was hauled without repair to a storage-battery locomotive armature.

Item 7—Battery charging labor of the storage-battery locomotive has no corresponding item for the trolley locomotive. This item is generally a small one for the underground metal mine, and the charging is usually done by a pump man.

Item 8—Trolley-system extensions, maintenance, and repairs, including maintenance of rail bonding, have no corresponding item for the storage-battery system. Maintenance of trolley-wire guard at chutes would come under this item. This item, of course, varies at particular mines, depending on underground conditions—whether the openings can be maintained easily or not, and so forth. It is, however, a material item of expense, not fully understood in many mines, because a part of it may be included in other work.

Item 9—The cost of power for the trolley system of haulage is generally assumed to be lower than that for the storage-battery system. Exactly the reverse is true, however. A material difference is in favor of the storage-battery system. The primary reason for this is the poor load factor and large size of motor-generator set required for the trolley system of haulage. For equivalent capacities, the size of the motor-generator set required for a trolley system of haulage would usually be three to four times the size of that required for the storage-battery system. During underground tramming, the motor-generator set for the trolley system must be kept in operation, resulting in a considerable loss of power. Also, the motor-generator set, being generally on the surface, involves transmission of direct current for a considerable distance to the shaft and underground, resulting in a considerable voltage drop and consequent loss of power. The use of the rail as one conductor, combined with wet conditions and wet overhead timber, generally results in considerable leakage of current and further losses of power. Considerable loss in power for the trolley locomotive occurs because of grid resistance. This is much less for the storage-battery locomotive. Under average conditions, the amount of power used by the trolley system would be about twice the amount used for the storage-battery system.

Item 10—Because of the much larger size of motor-generator set required for the trolley system, the electrical demand established is much greater for it than for the storage-battery system. Under almost all conditions, the electrical power cost is based in part on a demand charge or peak load. The cost for this electrical demand set up by the trolley system is much greater than for the storage-battery system. Another condition affecting this is the fact that most of the storage-battery charging work, done off shift, helps to equalize or increase the load factor of the mine. The trolley-system motor-generator set, however, is in service at the same time as the main electrical power demand for the mine, and this tends to increase the electrical demand and decrease the load factor. In other words, it increases, to a certain extent, the cost of power for the entire mine supply, over the cost for the same mine load where storage-battery haulage is used.

Table II shows a comparison of different cost items for the two systems under what might be considered average conditions for undeground metal mines. By average conditions are meant length of haulage, grades, and maintenance of drifts. Haulage equipment is provided of sufficient capacity to handle an annual production from 150,000 to 300,000 tons. The exact cost of items identical for the two systems is of relatively little importance, but it has been included to make the total cost as nearly complete as possible.

For an underground metal mine, under conditions as above noted, and for an annual production ranging from 150,000 to 300,000 tons, three 4-ton

Table II—Comparative Haulage Costs

	Trolley System		Storage-Battery System	
	Investment Cost			
Item 1:	Three 4-ton trolley locomotives, complete	$9,000	Three 6,000-lb. storage-battery locomotive chassis	$9,000
Item 2:	No corresponding item		Four lead-cell storage-battery units 28-30 kw.-hr., complete with box and transfer rack	8,000
Item 3:	Trolley wire system complete, including rail bonding, trolley-wire guards as needed	2,000	No corresponding item	
Item 4:	Motor-generator set, 75 kw., switchboard and shaft cables	4,000	Motor-generator set, 25-kw. switchboard and charging cables	2,000
	Total	$15,000	Total	$19,000
	Annual Depreciation			
Item 1:	Locomotives 16⅔% on $9,000	$1,500	Locomotive chassis 16⅔% on $9,000	$1,500
Item 2:	No corresponding item		Storage-battery units 25% on $8,000	2,000
Item 3:	Trolley wire system 25% on $2,000	500	No corresponding item	
Item 4:	Motor-generator set switchboard 10% on $4,000	400	Motor-generator set switchboard 10% on $2,000	200
	Total	$2,400	Total	$3,700
	Annual Operating Costs			
Item 5:	Locomotive operating labor, 6 men, 250 shifts	$7,500	Locomotive operating labor, 6 men, 250 shifts	$7,500
Item 6:	Locomotive repairs; labor and supplies	1,000	Locomotive and battery repairs; labor and supplies	500
Item 7:	No corresponding item		Battery-charging labor	500
Item 8:	Trolley system extension, maintenance and repairs, labor and supplies	1,000	No corresponding item	
Item 9:	Cost of power: 200,000 tons at ½ kw.-hr.; 40,000 kw.-hr. at 1.4c.	560	Cost of power: 200,000 tons at ⅒ kw.-hr.; 20,000 kw.-hr. at 1.4c.	280
Item 10:	Cost of electrical demand load over that for storage-battery system: 50 kw. at $10	500		
	Total	$10,560	Total	$8,780
	Summary Total Annual Cost			
	Interest on investment, 6% on $15,000	$900	Interest on investment, 6% on $19,000	$1,140
	Depreciation as noted	2,400	Depreciation as noted	3,700
	Operating costs	10,560	Operating costs	8,780
	Total	$13,860	Total	$13,620

trolley locomotives or three 5-ton, total-weight, storage-battery locomotives (including storage battery) provide ample capacity. For the trolley system of haulage, with the equipment mentioned in the foregoing, a motor-generator set of 75 kw. or larger is provided.

In many underground metal mines of approximately this size 100-kw. sets are installed. For storage-battery haulage with three locomotives, three lead-battery units of 28 to 30 kw.-hr. capacity would be sufficient, but four have been included in the figures, thus allowing one extra battery unit complete. A 25-kw. motor-generator set, or two smaller sets each one-half that size, would provide ample efficiency and capacity.

Investment Cost—The figures given in Table II for the original cost of equipment are based on conditions already noted. Total cost of the haulage equipment for trolley system is $15,000; for the storage-battery system, $19,000—a saving in favor of trolley haulage in first cost of $4,000, which represents an annual saving in interest cost on the investment for the trolley system of haulage of $240 per year with interest at 6 per cent.

Depreciation—Depreciation on the locomotives is figured on the basis of six years' life for either system. Undoubtedly, the life could reasonably be taken as longer, but this would make no relative difference. It is, if anything, unfair to figure only the same length of life for a storage-battery locomotive as for a trolley locomotive. For reasons to which attention has already been called, the storage-battery locomotive is generally found to average a somewhat longer life than the trolley locomotive, because of operation under a definitely controlled source of power. Life of the storage battery is placed at four years, which is somewhat unfair to the storage-battery system. If a five-year life were realized, this item of depreciation would be 20 per cent instead of 25 per cent. Motor-generator sets, together with switchboard and other equipment, are figured on a ten-year life basis, which estimate is undoubtedly rather conservative.

Operating Costs—As the exact amount required for locomotive operating labor would depend on mine production, the number of shifts operated, and other conditions, but would be the same for either system, the exact amount makes little relative difference. The cost of power for a trolley system of haulage is a difficult item to separate at many underground mines, because power for operating electrical scraper hoists and lighting is usually furnished from the motor-generator set used for trolley haulage. Elimination of this source of supply for these other uses would present no difficulty, however, and would generally result in a saving.

The alternating-current scraper hoist is now available. It has been in service in underground mines for many years, and has proved fully as reliable as the direct-current scraper hoist. The additional cost for the electrical demand load set up by the larger-size motor-generator set required for the trolley system of haulage is a difficult item on which to place any exact figure, as this would naturally depend on the rate schedule and basis in power contracts in force at the various underground mines. As already noted, under the storage-battery system the charging work can be done largely at off-peak periods, which tends to increase the load factor for the total electrical load at mines where that system of haulage is used. To estimate this increased cost of electrical demand for the trolley system of haulage as 50 kw. at $10 per kilowatt per year, or a total of $500, would be conservative. This amount would, in many cases, represent only a small portion of the total yearly increase in power cost resulting from additional demand.

The total annual cost for the trolley system is given as $13,860, as compared with $13,620 for the storage-battery system. Differences of opinion may arise in regard to items such as cost of power and repairs. Even making changes in these items to fit the conditions at any particular mine, I believe that under almost all conditions the final total figures would show that the difference in cost between the two systems of haulage is negligible. Taking into account the greater safety of the storage-battery system of haulage and the reduction in fire hazard where that system is used, these unquestioned advantages would seem sufficient alone to insure the much wider use of storage-battery haulage than is now prevalent, not taking into account other advantages, such as flexibility, possible saving in height of haulage drifts, and the ease with which extensions can be made underground.

This article has been prepared in the hope that it may lead to more detailed and exact consideration of this question of selection of an underground haulage system, and to the publication of significant data.

■ ■ ■

Remodeled Boiler Blow-Off Pipe Affords Additional Safety

THE blow-off pipe on a boiler is a necessity for safe operations, especially when the cleaning of the boiler is in progress. To afford all possible safety to the men employed in removing the scale within the boiler, a proper arrangement of fittings and the avoidance of leaky valves is essential. The general practice is to install the two necessary valves, with a cast-steel ell as an intermediate connection, as shown in Fig. 1 of the accompanying illustration.

Valve *A* is kept constantly open; and valve *B*, connected to the main blow-off line that is filled with steam under pressure, must be closed during boiler cleaning. From a mechanical standpoint, this arrangement is satisfactory and safe, provided valve *B* is not opened by an uninformed operator, and live steam permitted to enter the boiler through the ell and open valve *A*—thus trapping and severely scalding the operators. To avoid such an occurrence, C. W. Brown, assistant power plant engineer of the New Cornelia mines of Calumet & Arizona Mining Company, at Ajo, Ariz., remodeled the blow-off pipe as illustrated in Fig. 2. The change consists in the use of a cast-steel tee, with a removable blind flange in place of the ell formerly used. With the flange removed, steam can enter the boiler only in small quantities, the bulk being discharged through the open end of the inserted tee in the event of a sudden opening of valve *B*.

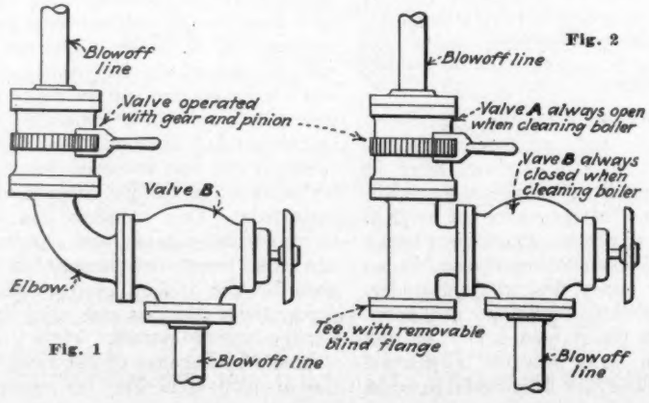


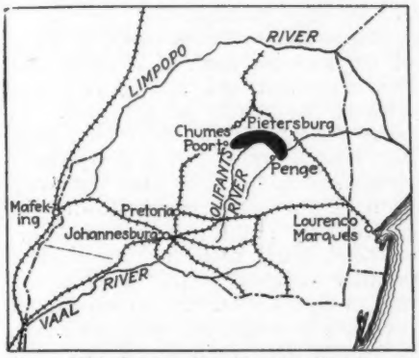
Fig. 1

Blowoff line
Valve A always open when cleaning boiler
Valve B always closed when cleaning boiler
Tee, with removable blind flange
Blowoff line
Fig. 2

Mining Amosite Asbestos in the Pietersburg District, South Africa

Dr. W. Kupferburger

Mineral Technologist, Board of Trade and Industries, Union of South Africa, Pretoria, Transvaal, South Africa



Sketch map showing situation of amosite deposit

AMOSITE is an amphibole asbestos that is composed principally of ferrous iron and silica, together with variable amounts of aluminum, calcium, and magnesium. Sodium may or may not be present. In crocidolite, or blue asbestos, the other closely related iron amphibole asbestos which is found under similar geological conditions in the Pietersburg district, sodium is an essential constituent.

The discoverer of amosite is unknown, but it was first recorded by A. L. Hall in an account of the geological survey of part of the Lydenburg district in 1907.

Amosite has been mined in the Lydenburg district since 1914. The occurrence of the mineral in the Pietersburg district has been known for a long time, and a few prospects were opened some years ago. In 1927, the deposits in the district attracted widespread attention; a large area of asbestos-bearing ground was pegged, and several new companies were formed for the exploitation of the amosite. In 1928, 6,748 tons, and in the first ten months of 1929, 9,682 tons of amosite were produced in South Africa, of which 2,158 tons came from the Pietersburg district. The total production of asbestos in the Union of South Africa is presented in Table I, which shows that in the last four years amosite has far outstripped chrysotile and blue asbestos in the rate of increase in production.

Table I—Asbestos Production in Union of South Africa

(Short Tons)

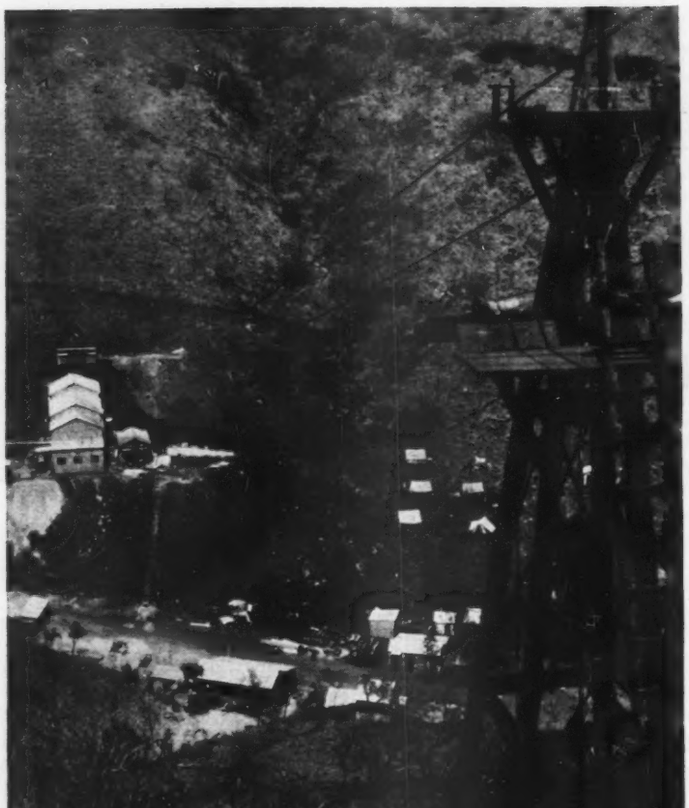
	1926	1927	1928	1929
Amosite.....	2,940	5,093	6,748	10,411
Blue asbestos....	4,024	4,874	5,144	6,289
Chrysotile.....	7,133	12,173	12,162	14,165
Total.....	14,097	22,140	24,054	30,865

In the Pietersburg district the principal mines at present are the "Chunes," Central, Seelig, S. A. Consolidated, Malipsdrift, Hancock's, Montana, Pietersburg, and Northern. The Malipsdrift mine is owned by the Egnep, Ltd., which company also works the amosite mines at Penge, in the Lydenburg district, and is a subsidiary of the Cape Asbestos Company, Ltd. The Montana mine is owned by the Dominion Blue Asbestos Company, Ltd., which also mines blue asbestos in the Kuruman district and is a subsidiary of Turner & Newall, Ltd. The acquisition of properties in the district by these two strong asbestos mining and manufacturing companies emphasizes the importance of these new amosite occurrences.

The area in which the newly opened amosite properties are situated is about 25 miles long. Occurrences of the asbestos are found along the extension of the same rock formation, first to the east and then to the south, as the strike of the formation swings into the Lydenburg district, where the Penge and Amosa mines, the large producers belonging to the Cape Asbestos Company, are situated.

The name "amosite," which was proposed by A. L. Hall in 1918, is derived from the word "Amosa," which was compounded from the initial letters of "Asbestos Mines of South Africa," the name of one of the pioneer concerns in the mining of this type of asbestos. It is now generally accepted as the trade name for this type of asbestos. Attempts have been made to coin new trade names for the fiber from different localities, but this tendency should be discouraged, as it can lead only to confusion. It is true that amosite from different localities and from different seams displays quite appreciable variations in chemical composition and physical properties, such as tensile strength, flexibility, and fineness of fiber. The same is also true of chrysotile and blue asbestos, yet these varieties are all marketed under the general name of blue or chrysotile asbestos. The particular properties of the fiber from the various producing sources, and its suitability for different manufacturing purposes, eventually become known to buyers and manufacturers. Amosite will no doubt stand as the trade name for the light-colored (varying from brown to various shades of gray) amphibole asbestos from South Africa. The different qualities and types of fiber can be indicated by a name or mark indicating the mine of

Narrow amosite seams (light-colored) in banded iron stones dipping almost vertically



Aerial tramway and mill at the S. A. Consolidated mine

origin, as is the practice with chrysotile asbestos.

The designation "yellow" fiber, which is used by some in the asbestos industry, is also a misnomer, because, although much of the amosite exported has been of a yellow to brownish-yellow color, this material has come from the oxidized parts of the seams. As mining operations penetrate deeper, the fiber assumes a paler grayish or greenish color, and the bulk of the amosite that will be exported in the future will be of this type, yellow and brown fiber probably disappearing from the market in a few years.

Light-colored bands of amosite, between which is a darker fibrous band of blue asbestos or crocidolite

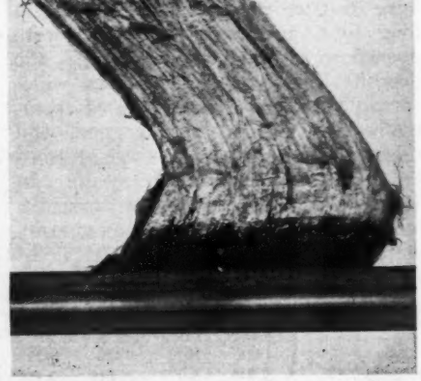
In physical properties, the fiber varies from a soft flexible almost silky variety, with great tensile strength, to a rather harsh and somewhat spiky or brittle fiber. This variation in the fiber is not confined to different seams, because sometimes the same continuous seam may be found to change from the one to the other variety.

The average length of the fiber is long, although not quite so long as that found in the Lydenburg district. Generally, the long fiber seams, that is from 3 in. upward, run as single seams with several feet of intervening rock. The shorter fiber seams, however, usually occur in so-called ribbon formation—that is, several seams up to 2 in. in width occur closely spaced together over a thickness of two or three feet or more.

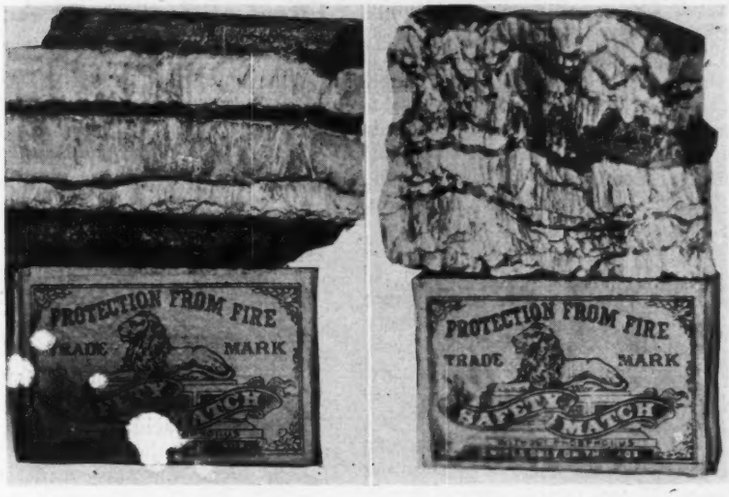
The country rock in which the asbestos seams are found is the banded ironstone formation, situated near the top of the Dolomite series of the Transvaal system. These banded ironstones are well-stratified, hard, siliceous rocks, with the iron minerals more highly concentrated along certain bands than others. In places there are thin layers of almost pure chert, and elsewhere the banded ironstones become shaly and softer. The banded ironstones containing asbestos are separated by intercalated layers of dolomite and some thin shale bands. Both the dolomite and shales are in places distinctly carbonaceous. The rocks of the Transvaal system, of which the Dolomite series is the middle member in this district, form the northern margin of sedimentary rock to the Bushveld Igneous Complex. Over the area in question, they strike roughly in a southwest-northeast direction and have a general dip toward the southeast. The structure is, however, severely contorted, and dips, varying from vertical to 20 deg. either approximately northwest or southeast, can be seen. Furthermore, in many places the asbestos-bearing layers have been subjected to intraformational contortion, and the individual fiber seams are strongly corrugated.

Whatever may be the mode of origin of the asbestos fiber, it is clear that this contortion and folding have not affected the quality of the fiber. In many formations the fibers have been bent and disturbed out of the position normal to the plane of the containing walls of the seam, which position is regarded by Peacock (*American Mineralogist*, July, 1928) as the original position assumed by the fibers at the time of their formation. In any lateral pressures to which the rocks were subjected, the fiber seams would have been the less competent members, and consequently would show the effects of movement to a greater extent than the intervening ironstone or chert layers. The fiber formation may also have been contemporaneous with the folding and been assisted by the lateral pressures that were responsible for the folding and contortion of the beds.

The habit of the seams is similar to that of the blue or crocidolite asbestos seams that occur in the Griqualand West asbestos belt and also in the lower ferruginous beds of the overlying Pretoria series in the same district. Individual seams often taper off or end in



A hand specimen of amosite, showing a fiber length of more than 4 in.



Left—Ribbon formation of amosite seams. Right—Irregular formation of amosite fiber. These hand specimens are shown about full size, the match box measures 1¼x2¾ in.

a sharp downward curve of one wall of the seam, only to continue further on in the same fashion. Several distinct asbestos-bearing horizons are recognized; these are separated by a few feet to a 100 ft. or more of barren rock. Individual fiber seams are not continuous over great distances, either laterally or on the dip, but the development work up to the present has shown the fiber-bearing horizons to be continuous in some places over several thousands of feet along the strike and several hundred feet along the dip.

According to G. J. V. Clarence *(Transactions:* Geological Society of South Africa, January, 1930), three main horizons have been opened up in mining and prospecting; these may be described as follows: (1) *Upper Horizon.* The usual channel width of this horizon is 8 to 12 in., consisting of three to four seams varying from 2 to 4 in. in width. The percentage of fiber in the channel width is about 90. (2) *Middle Horizon.* This horizon is situated about halfway between the upper and lower horizons. The usual channel width is 3½ to 4 ft., consisting of numerous seams ranging from ⅛ to 2 in. in width. The percentage fiber in the channel width is about 7. (3) *Lower Horizon.* At about 200 ft., true thickness, below the middle horizon, this lower horizon is found. Its usual channel width is 4 ft., consisting of numerous closely aggregated kinds of fiber. The fiber varies from ⅛ to 1½ in. in width. Percentage of fiber in channel width is 17.

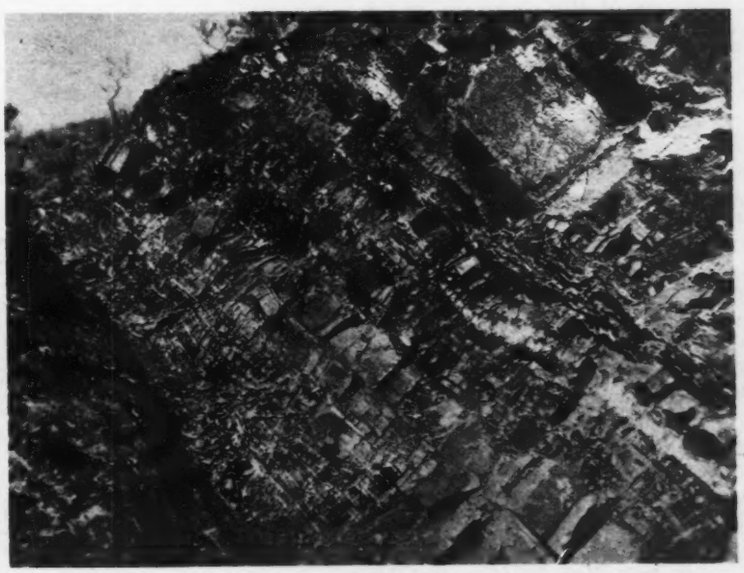
Fiber formation was undoubtedly determined by the chemical composition of the original rock and its reaction with circulating hydrothermal solutions emanating from the intrusive rocks of the Bushveld Complex. The fiber occurrences in this area are all well within the aureole of that intrusion, and would therefore be formed along certain definite horizons, along which the favorable chemical conditions existed; consequently, a certain continuity can be expected along the strike, as well as on the dip. Whether a definite correlation of the various fiber horizons over the whole area can be established remains to be seen. Sufficient detailed geological work has not yet been done to prove this point, but on several adjoining properties a close similarity in the vertical distribution of the fiber seams has been found.

Although the fiber horizons may not be continuous over the whole area, the changes are sufficiently gradual so as not to cause any undue difficulties in mining operations. The bedded and conformable nature of the fiber horizons is a favorable feature from the point of view of mining and in the planning of development work.

Transportation has been a costly item and one of the main difficulties in opening up the deposits. The country is mountainous in the region between Chunes Poort and the mines. By the existing roads, all of which pass through Chunes Poort, the nearest mines are about 35 miles, and the farthest about 70 miles. from Pietersburg, which is the present railhead. Transport of fiber and supplies is generally effected by ox or donkey wagon. Motor trucks are used for urgent needs, but, with gasoline selling at 70c. a gallon in Pietersburg, their running costs are prohibitive for general purposes. Animal transport costs for the mines 60 miles from Pietersburg are about £2 per ton, which is about 16c. per ton-mile.

Owing to the occurrence of the amosite as a series of interbedded seams in steeply dipping strata, and because of the highly dissected topography of the country, the fiber horizons are found in many different attitudes, the dip varying from vertical down to 20 deg. Open mining is therefore not feasible, and underground methods, depending upon the particular structural features, have to be adopted. A common method is to open up the fiber horizons from the outcrop along transverse valleys by a series of tunnels driven along the strike, and then to mine by stoping between the various levels. In view of the rough surface topography, aerial haulage will probably be extensively used to deliver rock from the various workings to the mills which must be situated in the valleys in convenient positions for transporting the fiber to the railhead.

It is impossible at the present stage of development to give a reliable estimate of the ore reserves of the Pietersburg field as a whole. Many factors, such as the highly contorted geographical structure and the folding on a large scale, as well as the minor corrugations of the fiber seams, would make any such attempt difficult. The



An outcrop, showing several small seams ¼ to 1¼ in. in width. The upper seam is 3 in. wide

Opening an asbestos-bearing horizon at the Montana mine by means of tunnels

quantities of asbestos must be enormous, however, in view of the existence of several workable fiber horizons and the total area over which asbestos is found. In this connection, too, the mountainous and highly dissected character of the country is advantageous, as expensive deep underground mining will not have to be resorted to, the fiber being worked from the outcrop at many places. Oxidation and discoloration of the fiber rarely extend more than a few feet from the surface.

As regards extraction and preparation of the fiber, most companies are still experimenting with some milling process for their own fiber. Because of the fact that the fiber and the containing rock are entirely different from those of chrysotile, for which most of the existing methods and plants for fiber recovery have been evolved, the ordinary accepted asbestos milling practice could not be directly applied to the treatment of amosite. The present method of preparation of the fiber is principally that of hand-cobbing, the product of which is passed through a series of rolls and disintegrators and then screened on shaking screens or rotary trommels into three grades. Most of the milling plants are small and have a capacity of about 50 tons per month: they are to be regarded only as pilot plants that can be changed and augmented as further experience in the production and treatment of the fiber is gained.

The South African Consolidated Asbestos Company has recently completed a mill of 200 tons' per month capacity. On one fiber horizon the company has asbestos rock developed and ready for mining several years ahead of the proposed mill output. On this property, only the short-fiber horizon is now being worked, but even for that the first-grade mill fiber gives a screen test of 4.7.3.2, showing that most of the amosite is of spinning length. On the basis of price, amosite will always have the advantage in length over chrysotile. The slight harshness of the fiber counteracts, to some extent, the advantage of length. Some of the amosite is fine, silky, and flexible, and can easily be spun; during the shortage of chrysotile, amosite spinning fiber has been used as a substitute for, and mixed with, chrysotile with good results. Adverse criticism of amosite as a spinning fiber for purposes for which chrysotile has always been used is unfair, because these two types of fiber are entirely different in nature.

Amosite is an amphibole asbestos in its chemical and physical properties, yet closely approximating chrysotile in the character of the fiber. For spinning purposes, the best quality chrysotile will probably always be supreme. Amosite, however, can be spun satisfactorily, and there are uses for which this type of fiber is found to be particularly suitable. It is extensively used in 85 per cent magnesia insulation products, in laggings, and packings of various kinds, in felted insulation products, in the manufacture of roofing shingles, and for asbestos cement board. For filter cloth and other applications in the chemical industries, it is found to be particularly suitable on account of its resistance to chemical solutions and acids.

The requirements that the manufacturers of asbestos products are called upon to satisfy are so diverse that, although comparatively new to the industry, amosite will find an established place in existing manufacturing practice. Moreover, additional new applications for this type of fiber will be found. Large and adequate reserves of amosite are available, and mining development work has been carried out well in advance of present requirements. Regular supplies of amosite, limited only by the demand for this type of fiber, can be expected from the Pietersburg district.

Pilot mill at the property of the Central Asbestos Company, Ltd.

Effect of Sealing on Acidity of Mine Waters

TO DETERMINE the effect produced on the acidity of mine drainage by sealing worked-out areas, R. D. Leitche, W. P. Vant, and R. R. Sayers, of the U. S. Bureau of Mines, undertook an investigation, the results of which have been published in Report of Investigations No. 2,994. Although only coal mines were considered, the report should be interesting to all mining companies troubled with acid water.

The accepted theory of acid formation in coal mines, with the subsequent appearance of the acid in the mine drainage, according to the report, is oxidation of iron pyrite and subsequent solution and hydrolysis of the iron sulphate formed. It has also been found that gobbed sections and worked-out areas, where there is usually an abundance of iron pyrite-bearing materials in contact with air, are the sections that make the most important contribution to acid drainage. It would thus seem obvious that, if oxygen can be kept out of contact with the acid-forming materials in the sections mentioned, the amount of acid in coal-mine drainage could be reduced markedly and corrosion problems and stream pollution in general mitigated thereby.

Samples of water were collected from both open and closed sections of a group of eight mines well scattered over a coal field in the southern half of Indiana. Particular attention was given to a comparison of the character of the water from opened and closed sections of the same mine from the viewpoint of ascertaining whether the procedure of sealing abandoned and worked-out sections of coal mines decreases acid formation.

Three of the eight mines so inspected apparently had no acid water in either open or sealed workings. The remaining five had strongly acid water in open sections and alkaline water in sealed territory. No sample from an open section of long standing was alkaline.

Of all samples taken from sealed areas none had free sulphuric acid, and only one was potentially acid.

The evidence seems conclusive that the sealing of worked-out or abandoned sections of mines results in inhibiting acid formation. By sealing, it is assumed that the practical exclusion of air has been accomplished.

Observations indicate that seals may be constructed to be practically watertight, a fact that is often doubted by mining men. At any rate, they must be made airtight by some means. It may or may not be necessary to provide a means of releasing pressure from these seals.

Considerable trouble and expense may be saved by mining companies, if the drainage is normally acid, by sealing such territory as soon as it is worked out or for other reasons abandoned.

New Publications

LES MÉTHODES DE PROSPECTION DU SOUS-SOL. *By E. Rothé, Dean of the Faculty of Sciences, Strasbourg, and Director of the Institut de Physique du Globe. Gauthier-Villars et Cie., Paris, 1930.*

SYSTEMATIC textbooks on geophysics in English are lacking, and this is apparently true in France as well, for the treatise being reviewed is intended to fill the gap for the benefit of French engineers, geologists, and physicists. To those who read scientific French it can be strongly recommended, if they desire to attack the study of geophysics in a serious manner. He who is looking merely for a layman's introduction, or a superficial view of the field of application of this science, had best leave it alone, for the treatment is detailed, thorough, and highly mathematical. Such treatment would be expected from this writer, who teaches physics at the University of Strasbourg and is the author of several texts on physics. The present book, the course in geophysics which he conducts at the university, contains the results of his own personal contact with or use of geophysical instruments and methods. Consequently, the approach is essentially that of the physicist rather than of the geologist.

The book describes successively the four principal methods of applied geophysics: magnetometric, electrometric, seismometric, and gravimetric. In each division the treatment followed is approximately the same: the principles and instruments are described, and the mathematical and physical bases are demonstrated upon which the methods rest. The theory behind the construction and operation of the instruments is outlined, together with details of their manipulation. Practical examples are used to illustrate the discussion of the field of application and interpretation of results.

For example, in the section on magnetic methods, the magnetic properties of rocks and minerals are studied, and the techniques best adapted to finding, on the one hand, magnetic substances, and, on the other, non-magnetic ones, are described, with citations of actual surveys. The gravimetric section is particularly complete. It begins with a chapter on "The Potential and Its Derivatives, Their Measurement," describes the various types of apparatus used in the field, and, before passing to the chapter "Interpretations and Examples," devotes 30 pages to "Topographic Corrections," their necessity, and the different methods of calculating them.

The book suffers from a lack of sufficient diagrams and illustrations in the sections on apparatus. Detailed treatment of the text would lead one to suppose that these sections were intended, in a way, as an introductory handbook for the operator. As such it might be successful with an instructor to demonstrate the instruments; but, lacking this, the reader is not sufficiently provided with illustrative sketches to enable him to attempt, alone, the manipulations envisaged. This is a fault arising, of course, from putting classroom exercises into print, but it seems to me that the value of the book could have been enhanced by giving fewer detailed descriptions of the operation of a few instruments and more general descriptions of a wider variety of apparatus (especially in the section on magnetism).

This criticism should in no way detract, however, from the high appreciation due the book as a thorough introductory course, from the physicist's point of view, on the theory and use of applied geophysics.

SHERWIN F. KELLY.

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THE UNITED KINGDOM—An Industrial, Commercial, and Financial Handbook. *By Hugh Butler, American Trade Commissioner in London, and officials of the Departments of Commerce and State. Published by the Bureau of Foreign and Domestic Commerce, Washington, D. C. Pp. 953; illus. Price, $1.75.*

A KNOWLEDGE of facts is the best basis for understanding the tangibles and intangibles that comprise the national life and commercial activities of any nation. In regard to the United Kingdom, many such facts are obscured by normal prejudices, or are unobtainable. Essential information is known to but comparatively few persons, being scattered in a vast number of publications.

Despite the employment of a common tongue by the two leading commonwealths in the industrial world, American industry as a whole has labored under the disadvantage involved by a lack of understanding of British commercial methods, which condition has been remedied by the issuance of the volume under review. Its 38 chapters are replete with information and statistics on industry and commerce in the British Isles. In readable form is given a picture of conditions under which each commodity is produced, supplemented with data on a host of related subjects, such as overseas trade and transportation facilities, a complete survey of British financial and insurance methods, and classified information on inter-empire and international commerce.

The text is accompanied by maps, charts, tables, and illustrations. A comprehensive bibliography and an index complete one of the most useful publications issued to date by the U. S. Bureau of Foreign and Domestic Commerce.

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GEOLOGY AND MINERALS OF MANITOBA. *By W. L. Goodwin. Gardenvale, Que.: Industrial and Educational Publishing Company. Pp. 260.*

THIS handbook has been prepared for the guidance and instruction of those desiring to prospect in Canada. It is the third of a series which, we understand, is eventually to include the entire Dominion within its scope. The first two dealt with Ontario and Quebec, respectively. In its plan, the book is essentially the same as the other two. After a preliminary chapter on minerals, rocks and rock structures, and mineral deposits, followed by one giving a short sketch of the geology of Manitoba, the rest of the volume is devoted to a description of the characteristics, occurrences and uses of the principal minerals of commerce that are either found in Manitoba or are likely to be found there. The book has been prepared especially with the purpose of aiding the non-technical man.

■ ■

INDUSTRIAL AND COMMERCIAL GERMANY. *New York: Hamburg-American Line. Pp. 187. Free.*

Following former practice, the Hamburg-American Line has issued a survey of Germany's economic position, containing short articles by experts dealing with the principal branches of industry, 51 in all. Other subjects treated are German foreign and domestic trade, banking systems, leading stock exchanges, and the most important industrial fairs. A Spanish edition is available for those who prefer the survey in that language.

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TABLES FOR THE DETERMINATION OF MINERALS. *By E. H. Kraus and W. F. Hunt. New York: McGraw-Hill Book Company. Pp. 266. Price $3.*

The first edition of these tables appeared in 1911. In the revision the tables remain essentially unchanged. A few minerals have been added, and, in several instances, varieties of minerals

already included have been incorporated under other colors. References to descriptions of minerals in various textbooks have been omitted in this edition. The introduction has been enlarged by the addition of several physical properties. The table in which the minerals have been arranged according to specific gravity should be of considerable value.

■ ■

LIMESTONES—ORIGIN, DISTRIBUTION, AND USES. *By F. J. North, Keeper of the Department of Geology in the National Museum of Wales. With a foreword by Sir Henry P. Maybury, president, Institute of Quarrying: sometime director-general of roads, Ministry of Transport. London: Thomas Murby & Company; 16 shillings. New York: D. Van Nostrand Company; $6.*

ALTHOUGH hundreds of articles have been written on the limestones of various sections of the world, no previous attempt has been made to prepare a general monograph on the subject. This volume, however, is scarcely so monographic in character as the title suggests, for it is concerned mainly with the British Isles. Nevertheless, the descriptions of origin, properties, and uses are world-wide in their application, and the volume should be welcomed by investigators and users of limestone everywhere.

Slightly more than one-half of the text is devoted to the geological distribution of the limestones of England, Wales, Scotland, and Ireland. The geological periods from the Pre-Cambrian to Recent are discussed, and the limestones of each are described, under distribution, characteristics, utilization, and adaptability. No one of the major geological divisions of these countries is entirely lacking in limestones, although in several they are of minor importance. Occasional references are made to foreign localities. The volume is valuable to any one seeking information concerning the limestones of the British Isles who is unable to search the vast literature that has accumulated.

The origin and properties of limestone are discussed in short chapters, and the uses at somewhat greater length. These data might have been expanded to advantage. One chapter on limestone and its relation to scenery and agriculture is of especial interest. The volume is well written, the illustrations are numerous, informative, and clear, with the exception of the photomicrographs, and the typography is good. Each chapter is followed by a carefully selected list of references.

Naturally, in a book of this kind, one can find paragraphs with which to disagree, but I note only a few of these. The work is useful and the author is to be commended for his efforts.

BENJ. L. MILLER.

MINERAL INDUSTRY OF THE FAR EAST. *By Boris P. Torgasheff, with a preface by Dr. Long Wen Hao, director, Geological Survey of China, Shanghai: Chali Company, Ltd. Pp. 510 with maps. Price £2 in British Empire; $10 (U. S. currency) elsewhere.*

Two books published in 1927 and 1928, in Russian and Chinese, respectively, form the basis for this volume. The work contains much statistical information dealing with 66 metals and mineral products covering the mining industries of China, Manchuria, Japan, Korea, Formosa, Indo-China, Philippine Islands, and the Russian Far East. Historical data are supplemented by geological notes, and the author has drawn largely from personal knowledge in discussing economic conditions prevailing in the various countries. The status of technology is summed up by the author when he says that "The lack of general knowledge of modern fundamental principles of mining, the insufficient number of properly trained mining engineers, and, most important of all, the almost total lack of local mining capital—these are the principal reasons why the Far Eastern mining industry still remains in the background." In the concluding chapter is a discussion of market possibilities of mineral raw materials, in which lengthy extracts are made from the market pages of *Engineering and Mining Journal*. The book, which concludes with a bibliography of 268 references, classified geographically, should prove a useful reference work in respect to the metal and mineral potentialities of an undeveloped but promising section of the world.

■ ■

SCIENCE AND THE SCIENTIFIC MIND. *By L. E. Saidla and W. E. Gibbs. New York: McGraw-Hill Book Company. Pp. 506; $3.*

Taking as a text the contention that "The future of our civilization depends on the widening spread and deepening hold of the scientific habit of mind," the authors have republished an excellent selection of essays, mostly by great authors, on the scientific mind and its relation to modern culture. An appendix comprises suggestions for the study of the structure of an essay, topics for oral or written discussion, a reading list, and biographical notes.

■ ■

STANDARDS AND SPECIFICATIONS FOR NON-METALLIC MINERALS AND THEIR PRODUCTS. *By John Q. Cannon, Jr., under the direction of A. S. McAllister, chief of the division of specifications, National Bureau of Standards. Washington, D. C.: Government Printing Office. Price $2.75.*

This volume contains the standards and specifications in regard to processed and raw non-metallic minerals. The original data were formulated by technical societies and trade or other associations. The book is the second of a series of monographs on standards and specifications in various industries. A decimal system of indexing has been used to facilitate reference. The volume will prove of high value as a permanent work of reference and information.

■ ■

MINING LAW OF THE UNITED STATES OF MEXICO. *El Paso: Llew H. Davis. Pp. 22. Price $1.*

This pamphlet, a translation of the mining law of Mexico that went into effect Oct. 1, 1930, should prove a valuable reference book for operators in that country.

■ ■

COMPRESSED AIR PLANT. *By Robert Peele. Fifth Edition. New York: John Wiley & Sons. Price $7.50. London: Chapman & Hall. Price 37s. 6d. Pp. 534; illus.*

SO MANY improvements have been made in compressed-air technique during the past decade that a revision of this book has again become necessary. New chapters have been added and old chapters have been rewritten. The structural characteristics of compressors are exhibited by numerous illustrations, with specifications of the types and sizes used by the principal builders in the United States and Europe. Seven chapters deal with the features of compressor design and operation, including cylinders, valves, governors, and unloaders, together with costs and performance of compressors. In the treatment of rock drills, piston drills have been dealt with only briefly. Hammer drills, on the other hand, have been treated at a much greater length than in the previous editions. New chapters have been added on performance of rock drills, drill bits, and mechanical sharpeners.

■ ■

CANADIAN MINING BOOK. 1930 EDITION. MONTREAL: *Thomas Skinner of Canada, Ltd. Pp. 410. Price $2.50 in Canada; $3 elsewhere.*

FINANCIAL, operating, and production details concerning about 1,500 Canadian mining companies are contained in this comprehensive volume. A directory of defunct and dormant companies lists 1,849 additional concerns. Data on mineral production of the Dominion, its mining regulations, and a directory of mining-company directors are included. This information has been admirably condensed, with the result that the volume—for all its more than 400 pages—is only three-quarters of an inch thick and is small enough to slip into the pocket of an itinerant mining engineer or investor.

Personal Notes . . . Comment . . . Criticism

C. H. Tuller is now superintendent of the Techatticup Gold Mines Company, at Las Vegas, Nevada.

A. Gronningsater, of Falconbridge Nickel, has returned from the company's refinery at Kristianssand, Norway, to headquarters at Toronto, Ontario.

John E. Penberthy sailed from New York on Nov. 28 for the Belgian Congo, where his address will be c/o Union Minière du Haut-Katanga, Elisabethville.

T. H. Jenks, who was called to England in August on account of his wife's illness, returned last month, Mrs. Jenks having passed away shortly after his arrival. He will in the future make his headquarters at 1221 Lucerne Boulevard, Los Angeles, Calif.

Kenneth Hickok, formerly with Cerro de Pasco at Quilacocha, Peru, and later with Cajabamba Mining & Milling, in the State of Ancash, Peru, has been awarded the Mine & Smelter research scholarship in metallurgy at the Colorado School of Mines, from which institution he was graduated in 1926.

Perry G. Harrison, general manager of the Evergreen Mining Company, Ironton, Minn., writes to correct an error in the issue of Oct. 23, 1930, page 393. The sentence relating to the size of the sintering machine should read: The size of the present sintering machine (Dwight Lloyd) is 18 x 72 in. x 127 *feet* as compared with 8 x 42 in. x 64 *feet.*

J. K. Bryan, general superintendent of the Ontario Refining Company, Ltd., of Copper Cliff, Ontario, has resigned his position there, to devote his entire time to his holdings in California real estate. The building and initial operation of the Copper Cliff plant have been carried out under his supervision. He will be succeeded by **F. Benard,** formerly assistant superintendent.

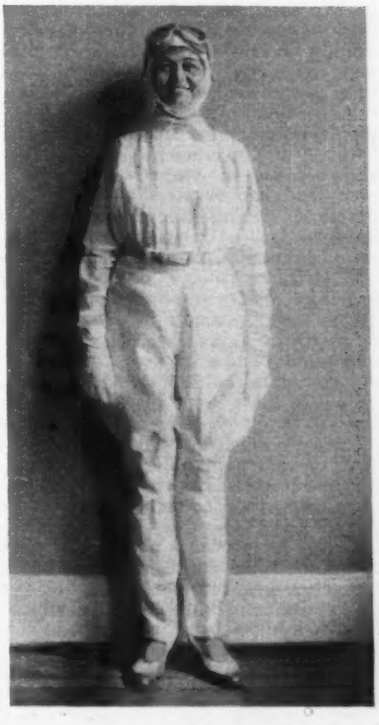
L. D. Anderson, who was with U. S. Smelting, Refining & Mining at Salt Lake City for the last 25 years, sailed late in November for Russia as a consulting engineer for the Freyn Engineering Company, of Chicago. His first assignment will be near Leningrad, but later he plans to proceed to Kuznesik, Siberia, where blast furnaces and steel mills are under construction.

C. F. Herington corrects two errors on p. 476 of the International Nickel issue (Nov. 10) in describing the powdered coal equipment at the Copper Cliff smelter. The screw feeders for delivering the coal to the reverberatory burners are driven from a line shaft by a 15-hp. motor; and the pulverizing mills are air-swept by means of Raymond exhausters to cyclone collectors.

Walter Harvey Weed, after a visit to Koeflach, in Austrian Styria, last summer, and an examination of samples taken from the alleged beryllium deposit there, has reached the conclusion that the claims as to beryllium content made by chemists and engineers at the property cannot be verified. This is in agreement with the statements made by A. Cissarz, H. Schneiderhöhn, and E. Zinth in *Metal und Erz* of July, 1930, referred to in *Engineering and Mining Journal* of Oct. 23.

Albion S. Howe, of Sutter Creek, Calif., asks: "Why should the United States buy gold to sell to the jewelers at cost? At present," he maintains, "the United States Assay Office is an appendage of the jewelry industry." Mr. Howe's recommendations are that "Uncle Sam should buy gold only for his own use for coinage purposes, to back up the paper money. If the United States bought copper, lead, and zinc to sell to bear the market, there would be a stir among the people interested in the base metals. The gold producers should market their gold without hindrance from the United States authorities."

Mrs. H. Foster Bain, wife of the secretary of the American Institute of Mining and Metallurgical Engineers, has just received a flying license after three



MRS. H. F. BAIN

months' instruction at the Newark, N. J., airport, and has purchased a Gypsy Moth biplane. Whether or not this means that Dr. and Mrs. Bain will henceforth visit local sections of the Institute by plane remains to be seen. The New York *World,* which gave Mrs. Bain some front-page publicity, heads the story, "Grandmother, 51, Gets Air License," and quotes her as saying, "I need a hobby of some sort now that my only daughter is grown up and married." The plane has been painted red and black and named the Cardinal, for her alma mater, the University of Wisconsin.

J. B. Carper, mining engineer for the Louisville & Nashville Railroad, points out that the railroads have a primary interest in the development of the mineral resources of the United States. The steady losses in freight and passenger traffic, which the railroads have suffered as a result of increased competition from trucks, bus lines, and other methods of transportation, could be checked by increased activity in the production of ores and minerals, he believes. Such activity would make this country even more independent, from a mineral standpoint, than it already is. Therefore he urges a more active participation by the railroads in the search for new mineral deposits.

L. Vogelstein, chairman of the board, American Metal Company, at a recent meeting of the Mining and Metallurgical Society of America, averred that the Sherman anti-trust law "has created gigantic financial trusts. It has worked against the small man, and particularly it has prevented us from rationalizing and stabilizing any of the industries. It should be permissible," Mr. Vogelstein maintained, "under certain restrictions, for any country or any industry to so regulate the production that it will not unreasonably exceed consumption, and in times of expanded trade to increase it again to an amount so that the increase in consumption can be readily taken care of."

D. T. McIver, president of Tonopah Premier Mining, suggests, in a recent communication, that company earnings of gold producers in the United States be exempted from income-tax payments. In the case of base-metal mines producing byproduct gold, he proposes that all operating expenses be charged against base-metal production, thus leaving the gross revenue derived from the gold output as profit. Mr. McIver believes that this measure, although involving a small loss in revenue to the government, would greatly stimulate gold mining and increase national supplies of that essential metal. He considers such a step justified by the fact that gold is the only product the price of which is fixed by the government.

Prof. **Georg von Hevesy,** of the University of Freiberg, non-resident lecturer at Cornell University, recently averred that geological methods for determining the age of the earth do not take account of the assumption that time-indicating processes proceed now at the same rate as they have in the past. Referring to the results of study of atomic transformation as a great advance in science, he added that "Geological methods give a lower limit to the possible age of the earth, while astrophysical methods supply an upper limit. . . . If the age of a human being is one second; of the human race, six hours; then the lower limit of the age of the earth is one year, and the age of the stars, 5,000 years," he concluded.

Dr. **F. R. Moulton**, at a recent meeting of the American Astronomical Society, averred that the meteor crater near Winslow, Ariz., is probably only a remnant of a vast mass of meteoric material. The possibility of finding any larger deposit than disclosed to date is slight, according to Doctor Moulton, who claims that an immense meteor would encounter enormous resistance on impact with the earth, resulting in its almost complete destruction.

Dr. **George Otis Smith,** director of the U. S. Geological Survey, states in his annual report that the strictly exploratory work of the Survey is now confined largely to Alaska, and that the more intensive phases of agricultural, industrial, and mining development have barely begun in much of the Western territory. With less than half of the United States topographically mapped, and with an endless variety of geologic problems awaiting attention, the exploration of resources cannot be regarded as complete. When its engineers are blazing trails in the forests of the extreme Northwest and Northeast, he is a rash prophet who see a speedy completion of the investigations of the Geological Survey, Doctor Smith adds.

A mining engineer, at the recent meeting of the San Francisco section of the A.I.M.E., asked a neighbor: "Why should gold have the price of $20.67, plus a long string of figures, per ounce? I have asked the question many times, but have never been able to get an answer." Nor did he get an explanation. However, the reason for the $20.67 plus its lengthy tail of numbers is easily discovered and no doubt has been explained countless times. The weight of a $20 goldpiece is established by law at 516 grains and its fineness at 900 parts of gold per 1,000 parts of coin alloy. A $20 goldpiece contains 464.4 grains of gold. A grain of gold is worth on this basis 4.30663 c. +. An ounce of gold would therefore be worth $20.67183 +. When the government buys gold, it gives for a given weight of gold its equivalent in gold dollars less certain charges. A dollar's worth of gold is 23.22 grains in weight.

George S. Rice, of the U. S. Bureau of Mines, and **F. F. Sharpless** are members of the advisory committee appointed by the American Engineering Council to guide the publishers in preparing the third edition of "Who's Who in Engineering." Summary biographies are requested from those who can qualify for inclusion, to comprise (1) engineers of outstanding and acknowledged professional eminence; (2) engineers of at least ten years' active practice, at least five years of which have been in responsible charge of important engineering work; (3) teachers of engineering subjects in colleges or schools of accepted standing, who have taught such subjects for at least ten years, at least five years of which have been in responsible charge of a major engineering course in such college or school. The editorial offices of "Who's Who in Engineering" are at 80 East 11th St., New York City.

F. J. Tuck, assistant mill superintendent, Nevada Consolidated Copper Company, Hayden, Ariz., writes of a use of copper instead of steel to reduce operating costs. "If all the companies in the world using wire on their Oliver filters would do as Nevada Consolidated does," he says, "a small but worth-while increase would occur in the use of copper, and the companies using it would find profit in the change. We use No. 6 B. & S. hard-drawn copper wire, spaced at 1¼ in., on the filters, and we find that it outlasts ten windings of steel wire, as well as more than doubling the life of the filter cloth. The original change from steel to copper was occasioned by the development of electrolytic action in the pulp, resulting in the pitting of the steel wire. This electrolysis dated from the change to a strong alkaline circuit in the selective flotation of the copper minerals. However, regardless of electrolysis, the copper wire proved more satisfactory than the steel, even when the latter was giving its best service, because rusting, which had hitherto deteriorated the canvas, was avoided. The copper wire," Mr. Tuck concludes. "may be used over and over again, as it is easily brazed. Finally, when ready for scrapping, it has a high salvage value. Copper that is worn off the wire is not lost; it goes into the concentrate."

The Engineer's Province

To the Editor of "E.&M.J.":

Dean Milnor Roberts of the School of Mines of the State of Washington recently hit the nail on the head when he expressed his belief that more attention should be paid to the financing of mining ventures by mining engineers, who are better qualified for this work than is the banker or the merchant.

According to my own observation, far more mining operations have failed because of insufficient initial finances, and because of operative guidance by men who had received no technical or practical mining knowledge, than because of lack of property merit. Analysis of properties, management, and financial structure should be the particular province of the mining engineer, whose duties should include advising the public as to the general merit or demerit of individual mining projects.

I do not mean by this that he should go out of his way to interfere with projects of which he does not approve, and relative to which he is not asked for advice; or that he should make attempt to foster enterprises with which he is acquainted, which he believes to be meritorious, and of which he receives no inquiries from clients or possible clients. Nor should he express opinion upon a project or property with which he is not personally acquainted, or upon which he is not provided with analyses by engineers personally known by him to be capable and conscientious.

If the mining engineer has the hardihood to occupy his true economic position it is one of hardship and difficulty. If he reports favorably on a property which by insufficient financing or inefficient management fails, he is blamed by the public. On the other hand, the engineer who is called on to examine a "prospect," with the idea that his report may be used to secure development finances, is cursed by the prospector and property owner if his report does not coincide with the ideas of the owners.

For example, recently I examined a gold prospect the owner of which claimed to have in sight many thousands of tons of ore of commercial value. I was asked to judge the property by the workings above water. I was shown zones where I was told would be found fine values. I found them there — samples ranged from one ounce to ten ounces gold per ton. But every one represented a tiny seam or vug. My own sampling, representing the width of rock that must be broken in order to mine the ore in these seams and vugs, showed an average of less than $5 per ton, in narrow veins, not allowing mass production.

Because I reported that this property as now developed cannot be mined profitably, and that the geology shown at surface and by development down to 400 ft. indicates a decrease in value on getting below the enriched zone into the primary zone, the owner characterizes me as an incompetent, and less. He says: "I have been a hard-rock miner for 30 years. I get stuff out of here right along which runs three, six, ten ounces gold per ton. I know where to get the values, and this engineer don't. All he can get is five dollars a ton."

Now then, this owner-prospector has been a miner for 30 years. He has been engaged in breaking and handling rock under the direction and responsibility of other men. He does not realize the difference between picked samples and values that must prevail in the mass of rock which must be broken and handled in order to enable mining operations to be commercially successful.

Thus the engineer is ground between two millstones. The public needs just as much protection from the well-meaning but impracticable prospector-owner as it does from the unscrupulous promoter. The mining engineer can find remunerative occupation in helping to guide actual mining operations as well as in helping to guide funds into mining enterprises that combine property merit, efficient management, and honesty of expenditure.

H. E. Davis.
Denver, Colo.

OBITUARY

Emory Cobb, map maker, of Phoenix, Ariz., recently died of heart failure at his office. He was formerly on the engineering staff of the Phelps Dodge Corporation, at Douglas, Ariz. Mr. Cobb was 41 years of age.

Marcus Daly, only son of the late Marcus Daly, founder of Anaconda Copper Mining and several other mining companies, died on Nov. 11. He was a graduate of Sheffield Scientific School of Yale University, and held directorships in several industrial enterprises.

William L. Gooch, master mechanic at the Sunnyside mine, near Silverton, Colo., died on Oct. 13 as the result of an accident occurring on the same day in the Terry shaft of the mine. He had worked for 30 years at the mine. Mr. Gooch, who was 58 years of age, is survived by six children.

Dr. **Richard Moldenke,** metallurgist, died late in November in a hospital near his home in Plainfield, N. J. He was born in Wisconsin in 1864, and was graduated from the Columbia University School of Mines, class of 1884. Doctor Moldenke specialized in castings and had made a life-long study of this branch of the metal industry. He was awarded the Seamon gold medal of the American Foundrymen's Association in 1925.

INDUSTRIAL PROGRESS

Carbon Arc Sunshine in Industry

W. C. KALB

National Carbon Company, Cleveland, Ohio

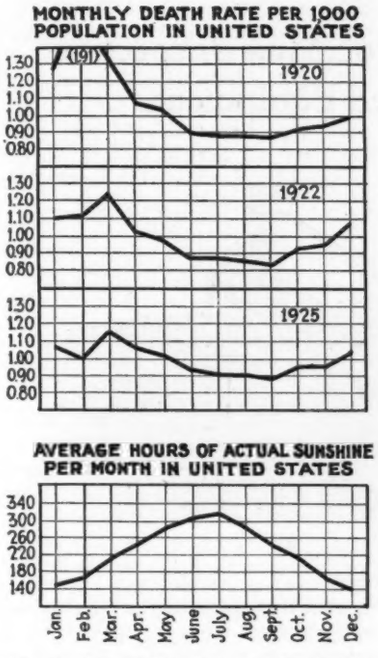


Fig. 1—Curves showing monthly death rate and average hours of sunshine in United States

EXECUTIVES in all lines of industry are giving recognition to the value of sunlight in maintaining the health and vigor of employees. This recognition is based on something more substantial than opinion. It is founded on an array of facts assembled by the medical profession and by scientific authorities. Mortality statistics prepared by the United States government, when compared with the reports of the U. S. Weather Bureau showing average hours of sunshine per month in the United States, give conclusive evidence of the influence of sunshine on health and vitality. This comparison is graphically presented by the curves in Fig. 1, which show the monthly death rate for three years, picked at random, and the average hours of sunshine per month over the entire country. It will be noted that the death rate reaches its peak in February and March following the meager sunshine of winter and is lowest in September following the abundant sunshine and outdoor life of summer.

Many Northern cities have much less sunshine in winter than is indicated by the curve for the country as a whole. The average daily hours of sunshine enjoyed by a typical northern industrial city are indicated by the lower curve in Fig. 2. The upper curve of this figure indicates the number of hours from sunrise to sunset, and the area between the curves represents daylight hours in which the sun is darkened by cloud.

But clouds are not the only factor limiting the benefits of sunlight. Smoke and dust in the city atmosphere screen out many of the invisible rays of sunlight which science has proved to be as essential to our health as food, water, and air. Few of these rays reach us on the clearest day of winter when the angle of the sun adds miles to the distance they must penetrate our atmosphere. Early morning and late afternoon sunlight is, for like reason, deficient in health - building power. Finally, our habits of dress and the compulsory indoor hours of business and industrial life allow the average individual but slight benefit from the vitalizing influence of natural sunlight.

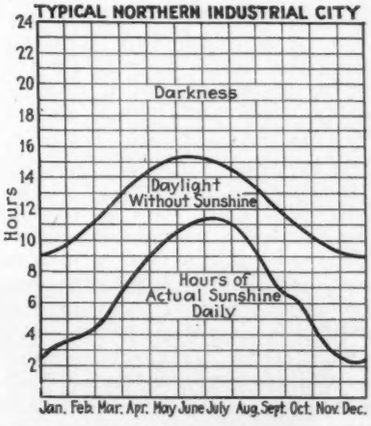


Fig. 2—Curves showing hours of sunshine in a typical northern industrial city

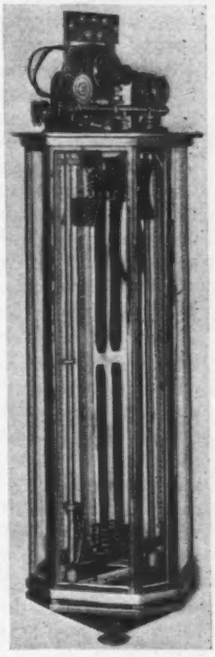


Fig. 3 — Powerful, dual trim, carbon arc lamp

To offset this lack of natural sunlight, farsighted employers are providing means for the irradiation of employees with artificial sunshine. It has been proved that the influence of these invisible rays on health is the same whether they come from the sun or from an artificial source of light. But man, having been for centuries accustomed to the light of the sun, reacts most favorably to that artificial source of light which gives the closest duplication of

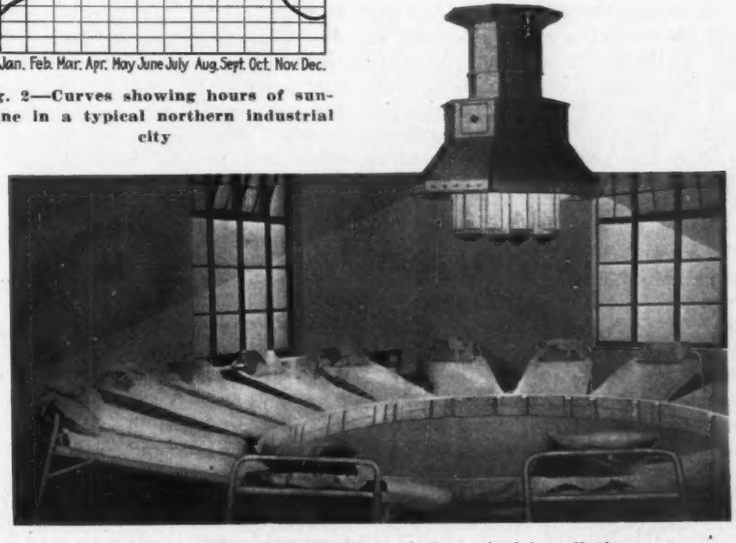


Fig. 4—Four lamp solarium unit in typical installation

natural sunlight, supplying ultra-violet, visible, and infra-red rays in essentially their natural proportion. The carbon arc light, burning carbons cored with a rare earth containing a high percentage of cerium, and screened with a special glass which filters out the very short ultra-violet rays, affords a close reproduction of the entire spectrum of natural sunshine.

A new lamp has recently been placed on the market which makes this artificial sunlight available in units of high power, giving radiation of natural intensity at a radius of several feet. This new illuminating unit is a dual trim, carbon arc lamp, illustrated in Fig. 3. Its size may be judged by the carbons, which are 12 in. long. A burning period of eight to twelve hours is attained by using two pairs of carbons. The arc burns between only one pair at a time but shifts from one pair to the other as the carbons burn back. This shift occurs without interruption of operation, at intervals of approximately thirty minutes. Arc current is adjustable between limits of 45 and 90 amp.

The motor-driven feed mechanism, operated by automatic relay, maintains constant current at the arc and assures uniform intensity of radiation. Panels of special, ultra-violet transmitting glass limit the radiation to rays common to natural sunlight. These panels are easily removed if it is desired to operate with a bare arc or to substitute quartz panels.

The inherent flexibility of the carbon arc characterizes this lamp. With "Sunshine" carbons, as noted above, natural sunshine is closely duplicated. Carbons cored with a different composition provide very powerful ultra-violet radiation and a still different type of carbon emphasizes the infra-red rays. This lamp is finding application in many industrial processes such as the irradiation of food products, stock and poultry feed, dairy herds, and dairy products. It is being used for fading tests on paints and dyes, where its great power and its availability 24 hours a day the year round effect a great economy of time. Further, its uniform intensity insures an accuracy in comparative tests that it is impossible to attain under the uncertain intensity of natural sunlight. This lamp has proved itself adapted to the bleaching of fabrics, oils, and other organic compounds and to processes involving the drying action of light, such as the manufacture of patent leather. New industrial processes dependent on the action of light, especially those requiring a powerful source of ultra-violet irradiation, are made practicable by this new development.

In view of the fact that the welfare of employees is acknowledged by the industrial leaders of today to be a factor of first importance, the adaptability of this lamp to group irradiation is an important element in its economic value. This should prove true to an unusual degree in the mining industry, where conditions of employment unavoidably deprive the workers of practically all of the health value of natural sunlight.

For group irradiation of industrial employees, and for use in private solaria, in hospitals and sanatoria, solarium units of one to four lamps each are available. The lamps in these units are grouped in one housing with suitably designed, chromium-plated reflector which affords an even distribution of light over a large area. The four-lamp solarium unit, illustrated in Fig. 4, provides an equivalent of summer sunshine over an area of 400 sq.ft., or a room 20 ft. square. The lamp is equally well adapted to installation adjacent to a moving platform, a method of group irradiation already in use.

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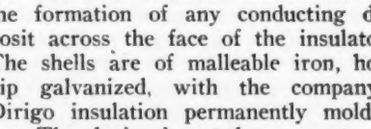
A Convenient Car for Mine Inspection —Other Varied Equipment

Mine inspection car, carrying four to six passengers

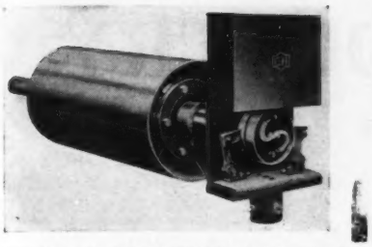
A mine inspection car built by *Jeffrey Manufacturing Company,* Columbus, Ohio, is shown herewith. It is not a locomotive, but is designed for transporting passengers, and is said to be speedy, comfortable, clean, and safe. For rendering first-aid service and quick transportation in time of accident, it is said to be excellent. It is of all-steel construction, with a wood-lined floor. It has a powerful headlight on either end and can make a maximum speed of 7 miles per hour. The underslung construction of the body prevents teetering or dragging when the weight is on one end. The car illustrated is 48 in. in gage and will carry four to six men besides the operator in a sitting position, or two men and an operator reclining. Its operation follows standard mine locomotive control. Electrical and moving parts are shielded. Braking is done by a quick-acting band brake on one axle, operated by a lever. The car may be equipped with either one or two trolleys.

Three new appliances for trolley haulage have been introduced by *Ohio Brass Company,* Mansfield, Ohio. One is a section insulator having an all-metal underrun. In combination with a sectionalizing switch, it is said to be satisfactory for interrupting the trolley circuit in mines or other systems. All wearing parts are easily removed. The metal underrun interposes two air gaps between the live parts, assuring perfect insulation. The second device is a universal harp, which can be easily accommodated to all angles of the trolley pole varying from horizontal to that necessary to reach a wire six feet from the ground. It may be had in self-aligning or non-aligning design. The harp follows wires and frogs with certainty, and accommodates either wheels or shoes. Harp and pole head are of malleable iron. The third device is a



Metal underrun section insulator

so-called K type air-gap mine hanger. The gap between the insulation and hanger shell provides additional leakage distance and appreciably raises the wet flashover value. It also restricts the formation of any conducting deposit across the face of the insulator. The shells are of malleable iron, hot-dip galvanized, with the company's Dirigo insulation permanently molded in. The device is rated to operate on all currents up to 550 volts. . . . Another company announcing new trolley appliances is the *Electric Railway Equipment Company,* 2906 Cormany Ave., Cincinnati. These include a so-called Type CD straight-line hanger, the insulating portion of which can easily be replaced, and a drop-forged double-curve pull-over, which is lighter



Magnetic separator pulley of improved wearing qualities

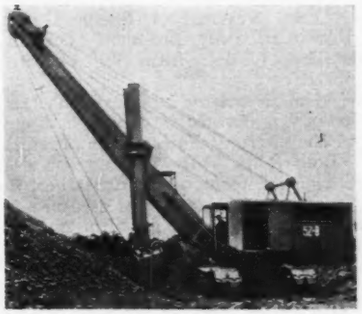
and stronger than when made of malleable iron. Another appliance is a single-curve pull-over, of the same construction as the double.

Other electrical devices announced include a special magnet for handling single railroad rails, introduced by *Ohio Electric Manufacturing Company,* Cleveland. This will lift a 30-ft. rail, weighing 130 lb., and will straighten itself out along the rail, requiring no attendant. It weighs 935 lb. and requires for operation 1½ kw. direct current. It is said to save time and labor as compared with old sling-chain methods. . . . *Cutler-Hammer,* Milwaukee, Wis., has brought out a new (Type W) magnetic separator pulley, which is simply constructed and has improved wearing qualities. It has three major parts—a machined cast-steel spool, magnet coils, and a coil shield, with necessary insulation. It has a dust-proof cover. The pulley is made in 12 in. diameter and in six lengths for belt widths of 12 to 30 in. . . . A portable tensile testing machine for testing welds in field or shop has been introduced by *Oxweld Acetylene Company,* New York. It weighs 165 lb., measures 28 in. over all and 6¾ in. in maximum diameter, is self-contained, and totally inclosed.

Among excavators recently introduced is a line of so-called "bobtail" electric shovels adapted for underground mining and tunneling. These are made by the *Thew Shovel Company,* Lorain, Ohio, the units being the Lorain Model 75-B, 55, and 45, the company's standard 1¼-, 1-yd., and ¾-yd. machines respectively, modified to meet the unusual conditions of the field specified. Extremely short tail-swing clearances are obtained by placing the electric motor at the front of the platform instead of at the rear of the turntable mechanism. The 75's tail-swing clearance is reduced from 10 ft. to 6 ft. 6 in. and that of the Model 55 and the Model 45 from 9 ft. to 5 ft. 10½ in. The silent chain

The new "bobtail" electric shovel

power take-off is merely reversed, and the same direct application of power otherwise obtained. These units, equipped with a 12-ft. boom and 10-ft. stick, can work in an opening 20 ft. wide and 15 ft. high with the boom at 45 deg. . . . *Bucyrus-Erie* has introduced a new Diesel shovel (52-B), which is convertible either to dragline, clamshell, or crane. It is of 2¼-cu.yd. capacity and has extra long and wide caterpillar mountings. The power plant is an Atlas-Bucyrus-Erie 4-cycle 6-cylinder, solid-injection, full-Diesel engine. This company is also equipping its E-2 Diesel dragline with an improved caterpillar mounting, having either standard or special long belts and special wide treads.



A 2½-yd. convertible Diesel shovel

A new wear-resisting metal, called "Supermal," has been developed for chains and buckets by *Jeffrey Manufacturing Company,* Columbus, Ohio. It is made by processing malleable iron in a certain way to give it extreme hardness and toughness. The company has introduced a line of chains and buckets made of it. In wear resistance, high tensile strength, and high elastic limit,

Bucket of specially processed malleable iron

chains made of this material compare favorably with manganese-steel chains.

. . . The design of efficient shaker-conveyor drives has always been difficult, largely because of the problem of securing the proper relation between acceleration and retardation with any of the accepted mechanisms. In a new drive (C-20) developed by the *Conveyor Sales Company, Inc.,* New York, the difficulty has been overcome by applying a new principle. This drive can be used in any plant where bulk granu-

This shaker-conveyor drive embodies a new principle

lar material is to be conveyed for comparatively short distances. In over-all dimensions it is 24¾ in. high, 84½ in. wide (plus from 20⅞ to 35⅝ in. for the motor), and 44 in. long. It weighs 6,400 lb. installed. The mechanisms consist of a gear train and crossarm, which convert the rotary motion of the motor into a reciprocating motion of a crosshead which is connected to the conveyor trough with minimum loss of energy. The peak velocity of the forward stroke comes beyond 120 deg. of the full revolution, and the peak of the reverse, or retarding stroke, before 240 deg., the ideal condition for such drives. All shafts are mounted in Timken bearings. The drive is said to require from 30 to 50 per cent less power and to be 50 per cent more efficient than the ordinary types.

Developments in the lubrication field include the introduction of a new series of gear lubricants for all types of heavy, slow-moving, open gears by *E. F. Houghton & Company,* Philadelphia. These are known as Tenac 1, 2, 3, and 4. This lubricant is not thrown off the gears, it is said, while they are in motion. The series has an extremely low cold test.

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BULLETINS

Hydrogen-Ion Measurement—Leeds & Northrup Company, 4901 Stenton Ave., Philadelphia, Pa. Notebook No. 3, 1930.

Protective Coatings—Headley Emulsified Products Company, Franklin Trust Building, Philadelphia, Pa. Bulletins 330 and 430, Water-proofing, dampproofing and emulsified asphalts and asphalt-base aluminum, respectively.

Reagent Feeder—Coeur d'Alene Hardware & Foundry Company, Wallace, Idaho. Bulletin No. 81. Precision liquid and flotation reagent feeders.

Electric Hoists—Coeur d'Alene Hardware & Foundry Company, Wallace, Idaho. Bulletin No. 53.

Speed Reducers—Falk Corporation, Milwaukee, Wis. Bulletin No. 230. Parallel shaft-speed reducers.

Stoker—Combustion Engineering Corporation, 200 Madison Avenue, New York. Catalog No. E-7. Type E stoker, center retort underfeed.

Pyrometers—Brown Instrument Company, Philadelphia, Pa. Catalog No. 15A. Indicating, recording, and controlling pyrometers.

Welder's Handbook—American Steel & Wire Company, 208 S. La Salle St., Chicago, Ill.

Air Filters—American Air Filter Company, Inc., First and Central Aves., Louisville, Ky. Bulletin No. 120. Air filters for compressors and Diesel and gas engines.

NEWS OF THE INDUSTRY

Depletion Taxation Chief Issue at Mining Congress Meeting

WIDE conflict of opinion on the method to be recommended by the American Mining Congress to determine depletion allowances for tax purposes finally was resolved in the adoption at the meeting in Washington on Dec. 4-6, of a resolution declaring that the present law governing the depletion should not be disturbed, except that there should be some amendment of the provisions relative to discovery, and that, if Congress should elect to prescribe percentage depletion, the rate should not be less than 33⅓ per cent of net income before depletion and in no event less than depletion under existing law. A committee was appointed to represent the congress at a hearing on Dec. 9 before the Joint Congressional Committee on Internal Revenue Taxation, whose chairman, Willis C. Hawley, of Oregon, stated in addressing the convention Dec. 4, that it is the committee's purpose to obtain a better distribution of depletion with greater simplicity. The members of the committee authorized to present the views of the congress to the Congressional committee are: Paul Armitage, of Douglas, Armitage & McCann, chairman of the national tax committee of the congress; A. P. Ramstedt, Hercules Mining, Wallace, Idaho; R. C. Allen, of Oglebay, Norton Company, Cleveland; A. G. Mackenzie, secretary, Utah chapter of the congress, Salt Lake City; A. Scott Thompson, Miami, Okla.; J. D. Zook, president and commissioner, Illinois Coal Operators' Labor Association, and H. B. Fernald, of Loomis, Suffern & Fernald, New York City.

Coal operators who attended the meeting had not agreed beforehand on the question which is vexing all branches of the mining industry, and the same lack of unanimity of opinion appeared to exist among metal-mine operators. A proposal to exclude coal mining in defining the position of the Mining Congress was rejected and the resolution framed to give the organization the semblance of a united front was adopted at a midnight session Dec. 4.

Mather Elected to Head Organization in 1931

Officers and directors elected at the December meeting included as president, S. Livingstone Mather, Cleveland-Cliffs Iron, Cleveland. Directors for the three-year term are: J. B. Warriner, Lehigh Navigation Coal, Lansford, Pa.; Erskine Ramsay, Alabama By-Products, Birmingham; A. E. Bendelari, Eagle-Picher Lead, Chicago; D. D. Moffatt, Utah Copper, Salt Lake City, and for two years, J. B. Putnam, Pickands-Mather Company, Cleveland.

Other officers elected include Mr. Bendelari, who will be first vice-president; Mr. Warriner, second vice-president; J. T. Skelley, Hercules Powder, Wilmington, Del., third vice-president; and J. F. Callbreath, of Washington, D. C., who was again re-elected secretary. Mr. Mather; L. S. Cates, president of Phelps Dodge; and Robert E. Tally, president of United Verde Copper, will form the executive committee.

The general meeting of the membership on Dec. 5 was devoted largely to a discussion of the internal affairs of the organization. Both R. E. Tally, of United Verde, the retiring president, and Mr. Mather, the new incumbent, recommended measures to place the organization on a firm financial footing. The appointment of a financial committee, the adoption of a budget system, and a regular audit of accounts set up according to the various divisions of the activities of the congress were urged with a view to establishing better order in the routine functioning of the organization.

Mather Favors Group Conference Meetings

Mr. Mather also suggested that the representation of the various industries in the congress contribute their proportionate share to its work, that the bylaws be amended to designate more clearly the qualified voting strength of such representation, and that a committee be appointed to determine the consensus of opinion on procedure at conventions. He expressed himself in favor of the group conference plan followed at this year's meeting. J. F. Callbreath, the secretary, stated that he was aware of the dissatisfaction which has been caused by deficits which had been incurred in various divisions of the congress, but said he was able to assure the membership that such debts would be cleared within the next four months. He explained that the deficits have been due largely to the efforts to develop the *Mining Congress Journal* and expressed confidence that from now on the *Journal* would more than pay its way.

Stabilization of the mining industry was originally scheduled for discussion at a group meeting, but this was cancelled on the eve of the convention, because it was felt that the congress could not take a position independent of that of the various branches of the industry. Mr. Tally stated that the time is opportune to have something done, but explained that the Mining Congress is helpless unless instructed by the industries which it represents. He recommended that the representation of the various industries present the matter to them for report to the congress for such action as they may desire. Mr. Tally noted that in his message to Congress, President Hoover paved the way for legislative action that may recognize the necessity for adjusting supply and demand in the mining industry.

Depreciation was listed for consideration as part of the program on mineral taxation, but an address by John T. Keenan, valuation engineer of the Bureau of Internal Revenue, failed to inspire any discussion of the subject. Mr. Keenan stated that the sole purpose of the bureau in setting up rates of depreciation based on the probable useful life of machinery and equipment was to be helpful to industry. He said that the preliminary report of the bureau will soon be made available, but did not indicate whether or not it would be placed in the hands of the field force in time for use in connection with income tax returns covering the present year. Mr. Keenan stated emphatically that the rates set up by the bureau are intended solely as a guide upon which the correct rates for the individual taxpayer may be predicated.

The board of governors of the southern division, at its annual meeting Dec. 4, decided to hold the next annual industrial development congress at Louisville next March, the exact date to be fixed later. Capt. R. M. Watt, of Pineville, Ky., who presided as chairman of the board, is also a member of the Kentucky Progress Commission, with which the congress is cooperating in making industrial surveys looking to the development of the natural resources and industries of that state. It is expected that at the March meeting detailed reports on this program will be presented.

Coal-mine mechanization and taxation of both coal and metal mines were the principal subjects discussed at group meetings on the opening day of the meeting. The first was a closed session. G. B. Southward, mechanization engineer of the congress, stated, following the conference, that discussion centered on the increased safety and better working conditions afforded by mechanization, and methods of gathering statistics on machine installations for exchange between different companies with a view to preventing duplication of experimental work. Dr. L. E. Young, chairman of the National Commitee on Mechanized Mining, presided.

Tally, Callbreath and Hawley Speak on Taxation

Mr. Tally stated at the conference on taxation that the organization would endeavor to obtain adequate allowance for depletion at the hearing before the Joint Congressional Committee on Internal Revenue Taxation on Dec. 9. Mr. Callbreath urged that all branches of the mining industry present a united front at the forthcoming hearing. The conference referred to the general tax committee for report on the following day a motion by A. P. Ramstedt, of Wallace, Idaho, for a recommendation by the congress to the Congressional committee, that instead of the present discovery depletion provision, the mining industry be allowed a depletion rate of 33⅓ per cent of the operating profit after depreciation, provided that this allowance shall not be less than if the allowance be computed on March 1, 1913, value, or at cost.

The meeting on taxation was addressed by Representative Willis C. Hawley, of Oregon, chairman of the joint committee. "The members of the American Mining Congress are, of course, now especially interested in the hearing before the joint committee to be held on Dec. 9," he said.

"This hearing was decided on by the committee last July, although it represented a departure from the usual custom to leave public hearings to the committees on Finance and on Ways and Means. In this case, however, the subject of depletion, on which a hearing was requested by representatives of the mining industry, is such a technical subject as seems worthy of special discussion. Also, the committee has before it the preliminary report of its staff, which indicates that the equity of our present system is doubtful, and recommends the study of methods which give some promise of securing a better distribution of depletion with greater simplicity.

"The attitude of the joint committee on this subject, or for that matter any other that it considers, is that it wants the facts. It desires to hear the views of those who have given the subject careful thought, no matter how divergent these views may be. Out of discussion which is conducted on a high plane, with due regard to the varying interests represented, there will often come light. I feel sure the committee will not recommend a change of doubtful propriety nor refuse to change a system which can plainly be improved. It must, of course, be kept in mind that the committee cannot merely have the interests of the mining industry at heart, but that it must also protect the government revenue, and ascertain that the mining industry is neither too favorably or too unfavorably treated with respect to the treatment accorded other industries."

Safety rules for installing electrical equipment in metal mines and the proposed safety code for coal mine transportation were considered in other group meetings. The board of governors of the southern division of the congress met in the evening for a discussion of the co-ordination program of Governor Bibb Graves of Alabama, and the future possibilities of Southern division work.

■

Stuart, James & Cooke Signs New Russian Contract

The Amtorg Trading Corporation announces the signing of a technical contract between the American firm of Stuart, James & Cooke and the Russian non-ferrous metals trust known as Giprozvetmet, under which Stuart, James & Cooke undertakes to give Giprozvetmet technical assistance in projecting, erecting, and equipment of copper, lead, zinc, and other non-ferrous metal mines, and also precious and rare metals mines. It also covers reconstruction and enlargement of already existing mines as well as supervision and consultation on operation and efficiency of the newly erected and organized mines. The contract is regarded as extremely important for the non-ferrous metal industry, as it virtually completes the plan for a complete American technical service, which gives Giprozvetmet technical guidance on all mining problems by Stuart, James & Cooke.

The Stuart, James & Cooke organization will sail from New York early in January to take up headquarters in Moscow. The present headquarters of the firm is in Kharkov, from where its representatives will continue to direct the work pertaining to projecting new coal mines, as well as of its engineers in Don Basin who are engaged in rehabilitating existing mines. Charles E. Stuart, president of the firm, is now in U.S.S.R. for the purpose of co-ordinating the firm's activities in coal and metal mining in various parts of U.S.S.R.

■

Report Provisional Agreement on Rhodesian Merger

Reports from London state that a provisional agreement has been reached for the acquisition, by Rhodesian Congo Border Concession, of the N'Kana property of Bwana M'Kubwa Copper, and the N'Changa property of N'Changa Copper. All three companies own copper deposits in Northern Rhodesia and their combined capital involves £4,025,-106. Rumors of a merger have been frequent in London recently. The ore reserves of the reorganized company would be well over 200,000,000 tons of ore, averaging 5 per cent copper, of which at least half is almost entirely sulphide ore and the remainder mixed oxide-sulphide ore. R.C.B.C. and N'Changa own adjoining ground to the west of the N'Kana Concession in which the Bwana M'Kubwa holdings are situated.

A special meeting of Rhodesian Congo Border shareholders will have to be called to create new shares to be issued in exchange for assets of the other two companies. One group is understood to be opposing the merger.

■

To Reopen Isabella Claims

Acquisition of the entire acreage of the Isabella Mining Company on the north slope of Bull Hill, Cripple Creek, Colo., by the Carlton interests, which control Golden Cycle and United Gold, has been announced. The terms of the deal have not been disclosed, but it is believed to be under a bond and lease arrangement. The mine will be reopened as soon as equipment can be assembled. A new hoist will be placed on one of the main shafts.

■

Utah Copper Cuts Output

Production of copper ore by Utah Copper, operating at Bingham, Utah, will be cut 8 per cent, according to D. D. Moffatt, vice-president and general manager of the company. The company, which has an effective milling capacity of 60,000 tons of ore daily, will decrease its tonnage from 27,500 to 25,000 tons. The rate of metal production at present is not known, as the company has suspended publication of quarterly reports. Utah is the first of the Kennecott-controlled group to announce a reduction in production, following the decision of the copper producers that further increases in stocks of metal must be prevented. So far as is known, Nevada and Braden are continuing to produce about 6,000 and 9,000 tons of metal monthly.

Salyer Consolidated Starts Trinity Hydraulic Project

One 7-in. hydraulic monitor is now in operation on the property of Salyer Consolidated Mines, in Trinity and Humboldt counties, Calif., 55 miles east of Eureka. The company is placing four additional Hendy monitors at work on the property, operating in four pits. At full operation, the daily yardage moved is expected to be about 30,000 cu.yd. About $500,000 has been spent in developing and equipping the properties.

The workings are located at the junction of the Trinity and South Fork rivers, near the Oregon boundary. Water is furnished by two lines, one 8 miles and the other 2 miles long, which assure operation for eight months of the year. Nine gravel beds have been exposed on the 1,700 acres controlled by the company, and the reserves of gravel available are estimated at 125,000,-000 cu.yd. The gold content is said to be from 30 to 50c. a cubic yard, in addition to iridium, platinum, osmium, palladium, and osmiridium. All of these metals have been identified by R. W. Drier, röntgenologist of the Michigan College of Mining & Technology. Prof. A. T. Sweet, head of the metallurgical department of the college, is metallurgical and ore-dressing consultant of the company. Robert Adams, of Houghton, Mich., is metallurgist at the property. C. L. Adams, mill superintendent of Mohawk Mining, and Professor Sweet jointly designed a new classifier for recovering fine particles of metal in the sluiceways. R. B. Brown, formerly of the La Grange mine, is mine superintendent and C. B. Dunster is consulting engineer.

■

California Mining Men Ask Aid for Gold Producers

On Nov. 22, 1930, at Redding, Calif., the northern chapter of the Mining Association of California passed several significant resolutions. One had to do with potential restriction of placer-mining operations on the Trinity and Klamath rivers and provided for a season of nine months' operation of the mines in the event that the legislature passes a law regulating hydraulic and placer mining in the interest of sportsmen.

Another resolution has for its objective the lowering of the present industrial compensation insurance rates, which are considered too high and restrictive upon mining activities. Opposition to any legislation tending to interfere with mining in areas covered by national forests was incorporated in another. The meeting favored the removal of the federal income tax upon gold mining and the prohibition of the sale of gold by the government for use in the arts.

■

Large Nugget Found in Guiana

A large gold nugget, weighing 15 lb., has been found on the Brokolonko concession, in Dutch Guiana, South America. It netted the finder 11,000 florins (par value of the florin is about 40c., U. S. currency). Dutch Guiana has a large area of auriferous land, but systematic prospecting has not been undertaken.

Bingham Metals at 1,100 Ft.

Sinking of the Bingham Metals shaft, at Bingham, Utah, has reached 1,100 ft. Development work is being started on this level to prospect the veins for copper-gold orebodies similar to those mined on the upper levels of the property. Shaft sinking is also being continued. On the 900 level, a drift is being driven to cut the downward extension of the high-grade ore recently struck in the Armstrong, or 710, tunnel level.

Utah Copper has completed the task of driving the Armstrong tunnel to connect with the main Bingham Metals shaft. The tunnel is 4,400 ft. long and will be used by Bingham Metals as an operating outlet. Utah Copper drove it for the company in exchange for dumping rights. The Bingham Metals hoist will be moved to the 710 level and the surface plant will be moved from the collar of the Nast incline shaft to the tunnel portal.

■

O. D. Buys Ariz. Commercial

Old Dominion has acquired the adjoining property of Arizona Commercial, at Globe, Ariz., for $20,000. Ore reserves of the latter company have been virtually exhausted, and the purchase was made largely on the basis of the salvage value of the equipment.

Old Dominion will connect its workings underground with the Arizona Commercial. The entire water flow will then be pumped out through the O. D. shaft. Both mines have long been known as among the wettest copper properties in the West. Better ventilation will also be made available through the connection of the two mines, and, in the event of a substantial improvement in the price of copper, Old Dominion may be able to extract some of the low-grade copper material left in the Arizona Commercial workings.

■

To Drill Duparquet Claim

Arrangements have been completed by a syndicate composed of Thayer Lindsley, I. Waite, and Prospectors' Airways, Ltd., Toronto, for drilling the Beatty property in Duparquet Township, Quebec, where favorable results have been obtained from stripping and trenching a gold-ore showing, 600 ft. west of the exposure drilled two years ago by Consolidated Mining & Smelting. One section of the exposure under sampling is reported to have shown an average value of $4.50 a ton across an average width of 36 ft. for a length of 360 ft.

■

Sloan to Address New Yorkers

The present economic situation, and some of the things necessary to improve it, will be discussed by Laurence H. Sloan, vice-president of the Standard Statistics Company, at the next dinner meeting of the New York Section, A.I.M.E., at 6:30 p.m., Thursday, Dec. 11, at the rooms of the Building Trades Employers' Association, 2 Park Ave. Reservations may be made through L. R. Strobel (Fitzroy 9668), and all who may be interested are invited to attend.

Budget Officials Cut Estimate of Bureau of Mines Fund

With half a million dollars lopped off the preliminary estimate, the budget of the U. S. Bureau of Mines for its regular work during the fiscal year starting July 1, 1931, represents a net decrease of $37,615 from the appropriations for the current year. The 1931-32 budget, as pruned by the U. S. Bureau of the Budget, calls for $2,314,385, of which $93,010 is for the helium plant at Amarillo, Tex., leaving a net for the Bureau's regular work of $2,221,375, compared with $2,258,990 for the current year after deducting $306,190 for the Amarillo plant.

Curtailment rather than expansion of the Bureau's activities is necessitated by the sharp downward revision of the government estimates prepared for the forthcoming year. More funds are available for only two features of the program that had been mapped out in the hope that additional sums would be furnished to meet the demands made upon the Bureau for its services. An increase of $25,950 is recommended by the budget bureau for the operation of mine rescue stations and cars, for the enlargement of the safety station at Jellicoe, Tenn., and for other safety work in coal and metal mining.

For investigation of the economics of the mineral industries, the budget bureau has allowed an increase of $36,080. Part of this fund will be used by the Common Metals Division for a study of the economic relationship of silver to copper, lead, zinc, gold, and other metals with respect to occurrence, production, metallurgical treatment, consumption and price, to indicate the effect of silver production in the general economy of the United States.

To handle satisfactorily numerous queries that the Bureau receives concerning the production, consumption, marketing and price trends of various metals, the Rare Metal and Non-Metals divisions will appoint an associate mineral economist to answer inquiries of this kind and prepare circulars containing more complete information than can now be presented in regular correspondence. A new advisory service also will be created as an aid to industrial development in the mineral commodities field. This new work will be in charge of Frank Hess, the Bureau's chief mineral technologist.

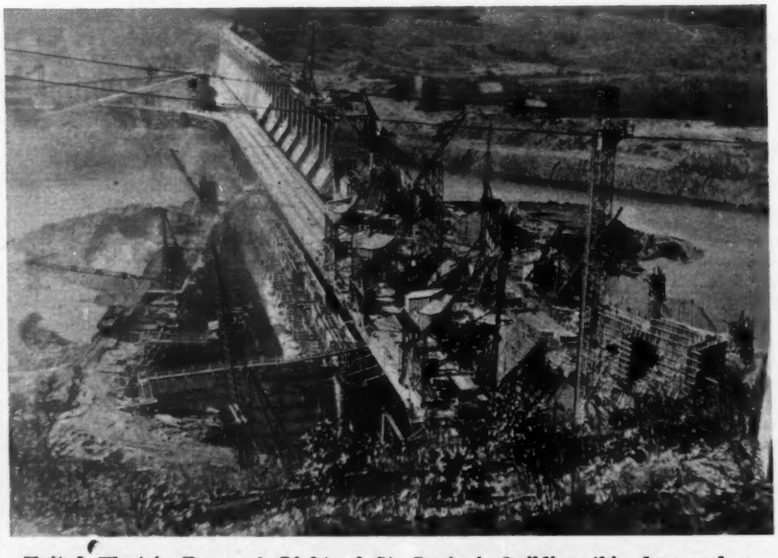
Two associate economic analysts will be employed by the petroleum-economics division to make a detailed study of the present demands for liquid and gas fuels produced by the petroleum industry and the economic factors affecting consumption.

Although the budget bureau's recommendation is much lower than had been anticipated, it is not likely that the House Appropriations Committee will authorize appropriations for the Bureau of Mines that are materially higher than those carried in the budget. Dr. Scott Turner, director of the Bureau of Mines, will appear later in the month before the subcommittee of which Representative Shreve, of Pennsylvania, is chairman, to explain the Bureau's needs and describe the effect that the budget bureau's drastic treatment will have upon its activities.

■

Nichols Curtails Production at El Paso Refinery

Nichols Copper, now the refining subsidiary of Phelps Dodge, is cutting the production of refined copper from its new plant at El Paso, Tex., from 8,500 to 6,600 tons a month, according to an announcement by C. W. Nichols, chairman of the company. Excess stocks of copper are given as the reason for the cut. The El Paso refinery handles blister from the smelters of Phelps Dodge and Calumet & Arizona, in Arizona. C. & A. has recently announced that its monthly output of copper will be cut from 3,750 to 3,250 tons. Phelps Dodge is also cutting down at its mines.



United Electric Power & Light of St. Louis is building this dam and a 178,000-hp. plant across the Osage River, near Bagnell, Mo. Much of the power will be used by St. Joseph Lead, chief producer in the southeast Missouri lead-zinc district. The dam is 2,600 ft. long and 140 ft. high. The entire installation will cost $30,000,000.

The building which will house a lead and zinc museum at Joplin, Mo.

Fresnillo Driving Crosscut to Cueva Santa Vein at 560 M.

Crosscutting from the Saraos shaft at a depth of 560 m. is now well under way at the Fresnillo mine, Fresnillo, Zacatecas, Mexico. The crosscut will be driven to the Cueva Santa vein, which carries the main sulphide orebodies on the property and which is estimated to be about 1,150 ft. from the shaft. More than a third of the distance has already been covered. The 560-m. level is 90 m. below the deepest level on which work has been done to date, and, even there, the orebody has been drifted on only within the last five months. At 425 m., on which development has been centered for the last year, ore has been proved for a length of 1,102 ft. in the east oreshoot and 1,502 ft. in the west oreshoot, with the west face still in ore.

Two winzes are now being sunk from the 425-m. level, and both show ore carrying better than average copper and silver contents. On the 470-m. level, the 354 ft. of ore opened up in the east oreshoot to date averages 11.1 per cent lead, 15.6 per cent zinc, 0.8 per cent copper, and 13.5 oz. of silver over a width of 4.8 ft. The company is continuing active development of the sulphide zone at and below the 425-m. level, not only to increase the ore reserves, but also to provide additional stoping area, thus making for improved ore production control at lower prices.

■

All-Flotation Methods Raise North Broken Recovery

Recovery has improved at the North Broken Hill concentrator, in New South Wales, Australia, since the company changed its plant to all-flotation methods. For the first two months of operation with the new flow sheet, recoveries averaged 94.2 per cent of the lead, 86.8 per cent of the silver, and 82.6 per cent of the zinc content of the ore, compared with 94.1, 86.2 and 77.7, the respective percentages for the year ended June 30, 1930, and 92.9, 83.3, and 76.8, the percentages for the previous year.

On the 1,550 level of the mine, ore has now been proved for a length of 1,576 ft., with widths and grade corresponding favorably to results obtained above. On the 1,700 level, ore has been proved for 647 ft. Sinking of the new shaft is progressing favorably. It will be 2,150 ft. deep when completed.

■

Joplin Museum to House Lead-Zinc Displays

A $15,000 concrete and stucco building has been donated by the Joplin Park Board to house a lead and zinc museum. The building is in Schifferdecker Park, Joplin, Mo. The ground floor is being used to house specimens of lead and zinc ores, mostly from the Tri-State district, but these collections will be augmented later with specimens of lead and zinc from all parts of the world, and possibly by specimens of other rare and precious metals.

One case, 4x6x26 ft. long, containing twelve sections, has been filled with lead and zinc specimens from various mines of the Tri-State district and by private collections donated to the museum committee. A number of private collections in individual cases are also housed on the first floor of the building, which has a dimension of 36x48 ft.

An exposition of the growth of the mining industry, in miniature, from the days of the hand windlass, whip, and horse hoister up to the present modern mill, is being built on the first floor of the museum building. The second floor will be used to house the products of the fabricators of lead and zinc, in addition to an underground model of the Oklahoma-Woodchuck mine of Interstate Zinc & Lead, near Cardin, Okla.

Three companies—National Lead, Eagle-Picher Lead, and Anaconda Copper—have built display cases for the second floor in which they are displaying the products they make. Other manufacturers have been invited to participate in the exhibition. A large number of galvanized, or zinc-coated, products are being sought for the finished product display.

The museum is in charge of Joseph H. Myers, chairman of the mineral display committee of the park board; Fred H. Nesbitt, of the Tri-State Zinc & Lead Ore Producers' Association; and J. H. Wadleigh, mining editor of the Joplin *Globe*.

Australian Drifting Record Set by Mount Isa

Mount Isa, the lead-zinc property under development in Queensland, has set a new drifting record for Australian mines. Three crews of ten men each, working three shifts, made a total of 469 ft. of advance during the month from Sept. 10 to Oct. 10. The working in which this record was made is the 350 level main-haulage drift, leading from the main hoisting shaft, the Urquhart, to the man-and-supply shaft. The drift measures 9x9 ft., driven slightly up-grade (1 ft. in 200 ft.). In driving the drift, the ground through which the working passed was a hard gray slate, heavily mineralized with pyrite.

Ingersoll-Rand N75 and S70 machines, with 1¼-in. hollow steel and mounted on vertical posts, 3½ in. in diameter, were used. Steel lengths ranged from 4 to 13 ft. About 26 holes were drilled for each round. A center cut was drilled, and all holes were fired by electric switch from the surface. A Butler air-operated shovel was used, loading into 14-cu.ft. cars. During the month, 4,331 cars were loaded. In loading holes, 60 per cent gelatin was used, with detonators placed in the second or third stick from the bottom of the hole. A total of 7,160 lb. of powder was used to break the ground. Shoveling did not start until 30 min. after blasting, compressed air being used for ventilation. A cycle of two rounds was drilled and blasted in the 24 hours. On some days as much as 17 ft. was driven.

In comparing these figures with records made outside Australasia, the fact should be borne in mind that 30 min. per eight-hour shift was lost in the heading because of the state law which requires the shift to be "from collar to collar." This accounted for 46½ hours during the month. In addition, another 30 hours was lost by reason of plant and machinery breakdowns, making a total loss of 76½ hours. Drill crews were made up of young Queenslanders, working on contract and furnishing their own powder. Many had never worked underground before.

■

Burma Reserves Up Despite Record Extraction

Burma Corporation, operating the Bawdwin mine, in India, estimates its reserves on June 30, 1930, at 4,265,665 tons of ore, averaging 25.5 per cent lead, 15.3 per cent zinc, 0.88 per cent copper, and 20.4 oz. of silver per ton. This shows an increase over the estimate at the end of the preceding fiscal year of 4,140,969 tons, despite the extraction of a record tonnage of ore during the year—500,585 tons. The new estimate does not include any portion of the Meingtha orebody, which has been under development for the last year only. This orebody has been developed on the Nos. 2 and 6 levels—480 ft. apart—and shows an average width of 30 ft. for a length of 1,100 ft. on the No. 2 level. The ore assays lower in silver, lead, and zinc than in the Chinaman and Shan orebodies.

Milling operations were featured by the increased recovery of lead and silver in the lead concentrates and of zinc recovery in zinc concentrate. Construction of additions, chiefly in the copper and flotation sections, have been completed. The lead concentrator now has a capacity of 45,000 tons of ore monthly.

BRIEF NOTES

Alta Tunnel. A high-grade silver-lead deposit of bedded and fissure ore is reported to have been struck by the company at its property in the Big Cottonwood district, near Salt Lake City, Utah. The strike was made on the 300 level of the Prince of Wales claim. Exploration for the deposit is now being undertaken on the 350 and 400 levels under the direction of E. V. Bodfish, manager of the company.

Cerro de Pasco Copper. No material change has occurred in the situation brought about by rioting at the company's properties in Junin, Peru, last month. At last report, all American employees were still at Lima and the mines were completely shut down, except for pump operation. In the news item in *E.&M.J.* of Nov. 24, on p. 537, the statement was made that "All Peruvian employees have been forced to leave the mining district." This, of course, should have read "all American employees."

Cherokee Gold Drift & Mining. The Cherokee placer property, one of the oldest hydraulic mines in California, north of Oroville, is being reopened by the company. It will be operated as a drift mine. John Sullivan and John Johnson are respectively president and general manager of the company.

Christmas Copper. Despite the present low price of copper, which results in operations being conducted at a slight net loss, production has been increased at the property near Hayden, Ariz. Mill capacity has been expanded, and the plant, originally designed for 400 tons a day, handled about 550 tons daily during the third quarter of the year. In addition, about 100 tons of direct-smelting ore is shipped daily. The average grade of milling and smelting ore, combined, is about 1.5 per cent copper. Mining, milling, and overhead costs are now about $2.70 a ton of ore, compared with $3.60 a ton in the first quarter of the year.

Columbia Gorge Mining. This company is preparing to sink an incline shaft, near The Dalles, Ore., to develop a copper-silver deposit struck in drilling a well on a golf course. The churn drill cut mineralization, assaying high in silver, at a depth of 286 ft. Subsequently, a diamond drill was put down to confirm the find and cut 4 ft. 3 in. of high-grade material. The Columbia Gorge Company was then organized by Harrison Taylor, who had been in charge of drilling the well, and was financed largely by mining men of Kellogg, Idaho. Mining equipment has been ordered by the company.

Electrolytic Zinc. The "G" orebody at the Hercules mine, near Rosebery, Tasmania, Australia, has been opened on the 5A and 5 levels, the latter being 139 ft. vertically below the 4 level. On both these lower levels, the orebody carries average width and grade at the points opened, but its extent has not yet been determined. If the length and width of the orebody are maintained, important additions to the ore reserves will result. A winze is being sunk from the 5 level to enable further exploration at depth. The ore extracted during the last fiscal year, and concentrated at Zeehan, averaged 21.3 per cent zinc, 6.4 per cent lead, 8.5 oz. of silver, and 2.12 dwt. of gold per long ton.

General Mining Corporation. This company is installing a 50-ton mill at its property in the Black Hills of South Dakota, where a small tonnage of high-grade gold ore is said to have been blocked out. An additional unit of similar capacity will be put up in the spring if development results continue favorable. About fifty men will be employed when mine and mill are in operation. Ore is mined through several small shafts as well as open cuts and tunnels.

Gunsight Detroit. Preparations for resumption of operations at the property, east of Ajo, Ariz., include the installation of a 50-hp. oil engine and a new air compressor. Machinery for a 50-ton concentrator, to handle gold-tungsten ore, is on the ground and is being assembled. Power for the mill will be furnished by a 120-hp. Diesel engine with which the mine had been previously equipped. W. S. Wheeler, of Detroit, is general manager, and J. D. Mitchell, of Chandler, Ariz., is superintendent.

Hedley Gold Mining. Following its custom of recent years, the company has suspended all work at its Nickel Plate mine, at Hedley, B. C., until the spring. Higher operating costs would result in a loss if operations were continued through the winter. The company has recovered barely enough gold this year to pay operating expenses. The property has been operated without substantial profits for ten years and furnishes employment to a considerable number of men.

Idaho-Maryland Mines. Preparations for transporting ore from the company's mine at Grass Valley, Calif., to the Brunswick gold mill are being completed. The plant, which has twenty stamps, is expected to be in operation by the end of the year. Idaho-Maryland also has its own 100-ton mill in operation.

Idaho Mother Lode Gold. About 70 mining claims on the south fork of the Clearwater River, in the Ten Mile gold district of Idaho, have been merged by the company, incorporated last month at Olympia, Wash., by W. G. Tanner, of Seattle. Diamond drilling and underground exploration are planned to prove the extent and the grade of the low-grade gold deposits outcropping on the properties. A crew of men is now at work. A good highway is available for transportation.

Lehi Tintic. The company has shipped a carload of high-grade lead ore from the carbonate deposit struck on the 1,100 level of its property in the Tintic district, Utah. The deposit has been opened for a length of 25 ft. and a width of 75 ft. on this level, although not all of the material is of shipping grade with present low metal prices. On the 1,250 level, the company is developing the same deposit.

McIntyre Porcupine. Development work on the property in the Porcupine district of Ontario has opened a series of new lenses of ore to a depth of 1,800 ft. on the old McIntyre and Plenaurum claims. Steel work on the new 2,000-ton mill is practically complete. The entire building is expected to be closed in before the severe weather starts. New mill machinery is beginning to arrive. Expectations are that the original schedule calling for completion of the mill by May 1 will be met.

Mexican Corporation. The company will continue operations at its Teziutlan unit, Puebla, Mexico, at the present rate, in spite of the fact that a small loss is being registered because of the low prices of copper and zinc. Costs have been reduced wherever possible, as the company desires to maintain production, pending the results of development at the Minerva orebody on the 370-m. level. A crosscut is now being driven from the shaft at that depth. Sinking of the shaft to 400 m. will be suspended until the 370-m. level has been developed. Production is about 180 tons of ore daily.

North Lily-Knight. Sinking of the Big Hill shaft at the company's properties in the Tintic district, Utah, reached a depth of 1,280 ft. on Dec. 1. The three shifts at work on the property are averaging about 200 ft. of sinking a month. The bottom of the shaft is now in the Cole Canyon limestone formation. Its objective is the Ophir formation of lower Cambrian age, which is expected to be found at 2,600 or 2,700 ft. When completed, the shaft will probably be the deepest in the Tintic district.

Panama-Nevada Consolidated Mines. A 630-ft. tunnel has been completed at the property, at Carrara, Nev. The tunnel connects with the shaft through which development was formerly conducted, and is expected to make ore extraction more economical. Arrangements are now being made to construct a 75-ton cyanide mill, tests having indicated an extraction of 97.5 per cent of the gold content. A new eight-drill compressor is being installed to push development work. About a two years' supply of ore for a 75-ton mill is said to be blocked out or on the dump. The company states that the grade is better than 1 oz. of gold to the ton over a width of 12 ft. Sol Camp is superintendent of the property.

Pandora Gold. Drilling on the property, in Cadillac Township, near Rouyn, Que., is reported by the company to have indicated, in its No. 5 deposit, an average grade of $16 in gold per ton over a width of 6.8 ft. These results are based on ten drill holes, put down over a length of about 4,400 ft., with the deepest hole cutting ore at 325 ft. A new vein has been discovered north of No. 5.

Royal Development. Operation of the company's new 200-ton concentrator, near Leavenworth, Wash., is now on a full-time basis, the plant having been started in November. Ore handled averages slightly less than 2 per cent copper. Concentrate produced will be stored until spring for shipment. The present mill is stated by the company to be only the first unit of a much larger plant, additional units being constructed as the mine is put in shape for larger production.

Santa Gertrudis. A new orebody has been discovered on the 17½ level of the company's Dos Carlos mine, in the Pachuca district, Hidalgo, Mexico. Preliminary reports state that for a length of 149 ft., the ore has averaged 10 dwt. in gold and 120 oz. of silver per ton, which is, of course, a remarkably high assay. The gold content, in fact, is the highest ever obtained by the company. Should the deposit continue in depth, the increased gold output will help offset the effect of lower silver prices on the company's revenue.

Anaconda and Subsidiaries Cut Output 10 Per Cent

Because of the tremendous accumulated surplus of copper on hand, Anaconda Copper has announced that it and its operating subsidiaries will cut copper production by 10 per cent. This announcement applies to the company's own mines at Butte, Mont., and Bingham, Utah; the Greene Cananea operations, at Sonora, Mexico; Chile Exploration, at Chuquicamata, and Andes Copper, at Potrerillos, Chile. Whether it will also affect the Walker and Inspiration mines, in which Anaconda has a large, if not controlling, interest, is not yet known.

At Butte, the company has closed down its Steward mine and transferred the men employed there to other shafts in the district. Data on the current rate of production at Butte are not released, but estimates place it at about 50 per cent of capacity, or 7,500 tons of copper monthly. A 10 per cent cut will therefore mean an output of 6,750 tons monthly. At Chile Exploration, the rate has been about 7,500 tons monthly, and at Andes Copper, about 3,900 tons monthly. Both of these figures represent 50 per cent of rated capacity.

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Blaylock Discounts Reports on Big Missouri Mine

Statements regarding the size and grade of the Big Missouri orebody, in the Portland Canal district of British Columbia, that are reported to have been made by Duncan MacVichie, consulting engineer for Big Missouri Mining, have been characterized as "regrettable" by S. G. Blaylock, general manager of Consolidated Mining & Smelting. The latter company controls Buena Vista, the concern organized to take the property over from Big Missouri Mining in return for a 47 per cent stock interest.

Mr. MacVichie's statements were made at Tacoma, after returning from the property, and were widely copied by Pacific Coast papers. Among other things he is reported to have said are that Big Missouri shows greater possibilities than the famous Premier Gold mine, in the same district; that 22 drill holes had been bored within 2,100 ft., and that assays taken over 2½ ft. average $9 in gold per ton and as high as 100 oz. in silver and 34 per cent lead. He added that a 250-ton mill will be in operation by Dec. 15, and that it is proposed to build a 2,000-ton mill soon, as enough ore is available to keep it running at full capacity.

In an interview with the Vancouver *Daily Province*, with regard to these statements, Mr. Blaylock said: "I am sure Mr. MacVichie cannot have been correctly quoted in this article. It is true that a 100-ton pilot mill is nearing completion. This mill will check up the value of the ore taken out in development, and will serve as a pilot mill to work out the milling problems in connection with this deposit. It is also true that there are some areas giving high assays in gold. The article, however, gives an impression which is not justified by the work done to date, and on that account must be considered regrettable."

Consolidated has suspended operations at the Emerald group on Sibola Mountain, which is on the east slope of the Coast Range, until the spring. Because of the altitude and the severe winters, continued development work at present is not justified. The property is at an elevation of about 6,000 ft. and carries lead, silver, zinc, copper, and gold.

Consolidated is importing high-grade phosphate rock from Montana and Idaho for manufacture of triple superphosphate. Mr. Blaylock states that the company is taking advantage of its ability to get this rock while it is developing its own deposits of low-grade rock at Crowsnest, near the Alberta boundary, and at Fernie, to assure the indefinite life of the new fertilizer plant, the first unit of which is costing the company $10,000,000. The manufacture of triple superphosphate will be started in January and of ammonium phosphate as soon as the ammonia plant is completed, probably early in the spring.

■

Enlarge Hoboken Refinery

Société Générale Metallurgique de Hoboken, subsidiary of Union Minière, is expanding the capacity of its electrolytic copper refinery at Hoboken, Belgium, to 110,000 metric tons annually, or about 125,000 short tons. The company handles blister output of Union Minière as well as some custom business. During the fiscal year 1929-1930, production was 67,000 metric tons. As Union Minière also produces refined copper from its Panda leaching plant, which has an annual capacity of 30,000 metric tons, when the Hoboken plant expansion is completed, very little, if any, of the Katanga output will have to be shipped to the United States for refining.

■

May Add to Leadville Tunnel

The withdrawal of American Smelting & Refining from the Yak tunnel, noted in a previous issue, has revived interest in the possibility of completing the Canterbury tunnel at Leadville, Colo., to its ultimate destination in South Evans Gulch, about 8,000 ft. from the portal. It is already in more than one-half this distance.

The Canterbury tunnel is on the north side of the district and its elevation is 169 ft. lower than the Yak. It is in first-class condition, with a water flow of 1,500 g.p.m. and the possibility of selling this water to irrigation companies if a dam or reservoir is constructed. This tunnel could drain such well-known properties as the Coronada, Fryer Hill, Great Hope, The Big Four, and Colorado Prince.

■

San Pedro Shaft Near Bottom

Completion of the new operating shaft, being sunk at the San Pedro unit of American Smelting & Refining, in the State of San Luis Potosi, Mexico, is expected soon. Sinking of this new shaft, which has five compartments and will be 2,000 ft. deep, was started about the middle of 1929. It will provide a more economical means of extracting ore from the property and will also permit increased production whenever market conditions justify.

At present, San Pedro is shipping 2,000 to 3,000 short tons of direct-smelting lead-silver ore to the San Luis Potosi smelter, owned by the same company, monthly. No action has yet been taken on the proposed construction of a 500-ton flotation plant at San Luis Potosi to treat low-grade San Pedro ore before smelting.

Park City Con. to Explore New East Crescent Vein

A winze is being sunk from the 400 level of the Park City Consolidated property, at Park City, Utah, to prospect the East Crescent vein, recently discovered 1,370 ft. southeast of the main shaft. This vein appears stronger and more heavily mineralized than the Silver vein on the 400 level, according to J. J. Beeson, vice-president and general manager of the company, in a report on operations. Three or four other veins that outcrop on the surface south of the present workings will also be explored. The company is issuing additional shares, in the ratio of one to each stockholder for every ten shares held, to finance this development.

Production in September and October averaged 100 tons of ore daily. Despite the low metal prices prevailing, particularly for silver, which is the company's chief product, an operating profit was made in both months. Mining costs have been cut to $3.27 a ton, to which must be added about $1.85 for smelting and transportation. The average silver content of ore shipped has been about 21.5 oz. per ton, in addition to from 1 to 2 per cent lead and 1.5 to 3 per cent zinc. Only a small amount of carbonate ore, which carries only silver and gold, has been shipped.

Ore reserves are estimated by Mr. Beeson at 29,485 tons of sulphide ore blocked out and 17,576 tons of possible sulphide ore and 18,648 tons of possible carbonate ore. These estimates are based on average thicknesses that are considered conservative by the management, as such stoping as has been done shows that the ore often widens out. Additional ore reserves are expected, because the carbonate ore estimated is above the 500 level and most of the sulphide ore estimated is below the 700 level. The carbonate oreshoot is expected to connect with the Silver or the Roosevelt vein. Both veins carry the sulphide orebody.

■

Coolbaugh and Joyce Report Interest in Colorado Mines

Increased interest in Colorado metal mining, as indicated in several ways, has been reported to the Colorado Association by members of its mining development committee. This association was formed two years ago along the lines of Californians, Inc., to further the development of Colorado. Its attention heretofore has been devoted largely to agriculture and tourists, but from now on mining will receive more.

At a recent meeting of the committee, M. F. Coolbaugh, president of the Colorado School of Mines, chairman, announced that during the last several months there has been a considerable increase in the number of ore samples sent by prospectors to the school for study. He further said that commercial assayers had reported a similar increase in the number of samples received by them for assaying, and that in addition he had noted a greater interest in Colorado's non-metallic minerals than in past years.

John T. Joyce, state commissioner of mines, gave the information that his department has received more inquiries regarding metal mining in Colorado during the last four months than in the last four years. Furthermore, the commissioner said, his inspectors reported a considerable increase in activity in old gold camps.

EXCLUSIVE

CABLES

FROM CORRESPONDENTS IN THE PRINCIPAL MINING CENTERS

Mount Lyell Report Shows Record Copper Output

Melbourne, Nov. 29.—A record copper production is the outstanding feature of the Mount Lyell annual report for the year ended Sept. 30, 1930. The output was 9,817 long tons, compared with 7,869 long tons in the preceding year. Profits, however, were adversely effected by the lessened demand and lower price of the metal, dropping from £324,128 to £131,177. Extraction of ore from the mines in Tasmania was 244,535 long tons, an increase of 71,267 tons, although the grade dropped from 4.95 per cent to 4.41 per cent copper. Concentrate production was 49,388 long tons, assaying 18.15 per cent copper. The recovery of the copper content in concentrate was 93.6 per cent, compared with 92.99 per cent in the previous year.

. . . . Ore reserves have been increased in the low-grade areas, but the tonnage available in the high-grade North Mount Lyell mine is now estimated at only 856,561 long tons, averaging 5.25 per cent copper, compared with 1,013,672 tons of the same grade last year. In the Lyell Comstock mine, reserves are estimated at 750,000 tons assaying 3 per cent copper, and in the Royal Tharsis at 2,500,000 tons assaying 2.25 per cent. The total reserves contain about ten years' production of copper at the increased rate of 13,000 long tons annually, for which the metallurgical plants are now being equipped. In addition to these reserves, developments of the last two years have indicated considerable tonnages, assaying 1.5 to 2 per cent copper, in the Crown and Lyell Tharsis leases. This low-grade material is of great importance to the future, although as yet it cannot be definitely placed in the category of ore reserves, because of the low price of copper.

. . . . Completion of construction work at the mill, smelter, and refinery is expected to permit of production at the increased rate of 13,000 long tons annually beginning in January. Australian copper consumption has fallen off, so that the company has had to export larger tonnages of metal than usual. In addition, the stock of copper on hand has increased by 1,150 tons during the year.

. . . . Electrolytic Zinc reports for the quarter ended Sept. 30 an output of 13,529 long tons of zinc and 59 tons of cadmium from its plant at Risdon, Tasmania. This indicates operation at full capacity.

. . . . The Australian government proposes to advance £100,000 to assist in the development of oil-shale deposits in New South Wales in which the Broken Hill companies are interested. A company known as Shale Oil Investigation, Ltd., to hold the leases, which are estimated to contain 20,000,000 tons of shale, has already been formed.

. . . . Drilling in the Bulowat placer area by Placer Development, which controls several New Guinea alluvial deposits, is reported to have resulted favorably. The company is now preparing plans for equipment of the area with dredges. Bulolo Gold Dredging, which was similarly developed by Placer Development and which has since been floated off as a separate, although partly subsidiary, company, reports excellent progress. The first shipment of dredge material into the property will be made early in January.

■

N'Kana Pilot Mill Makes 50 Per Cent Concentrate

London, Nov. 28.—During the September quarter, Bwana M'Kubwa Copper, operating in Northern Rhodesia, reports that the pilot mill at its N'Kana property treated 16,476 tons of copper ore. The concentrate made averaged 50.66 per cent copper. Some of this product was smelted at the Bwana plant and yielded 139¾ short tons of copper, the first shipped from N'Kana. Development work driven during the three months amounted to 5,346 ft. of underground workings. Sinking of the central shaft, through which most of the ore will be hoisted, has reached a depth of 332 ft. and the new headframe is completed. Ore reserves are estimated at 100,000,000 tons averaging 3.9 per cent copper, compared with the estimate of 66,000,000 tons averaging 4.2 per cent, made six months ago. The present reserves are sufficient for fifty years of operation of the initial 5,000-ton mill unit.

. . . . At the Bwana plant itself, a total of 83,458 tons of ore was leached, averaging 2.88 per cent copper. The recovery was 83.62 per cent of the copper content, results that compare favorably with those obtained in previous quarters.

. . . . Progress made in sinking shafts Nos. 3, 4, 5, and 6, as well as the Selkirk main shaft, at the Mufulira Copper property, will soon multiply the number of headings available for underground development work and permit a substantial increase over the present rate of blocking out the orebody. In the third quarter, Mufulira drove a total of 1,372 ft. Equipment is now being erected to permit sinking of the Selkirk shaft to a depth of 1,000 ft. Drilling has confirmed the management's theory that the Mufulira orebody pitches northwest, as holes put down in that area show it to be continuing with good grades and widths. The colored labor supply at Mufulira is now said to be somewhat in excess of the mine's requirements.

. . . . Geological work in the Chambishi basin was continued by Rhodesian Selection Trust during the September quarter, according to the company's report, but results obtained were negligible. Drilling on the orebody, on the other hand, continues to add to reserves. Five holes are now being put down. A compressor has been installed, permitting the inception of shaft-sinking operations. Transportation will soon be available to the property by rail, as the branch line that is being extended from the N'Kana to the N'Changa-R.C.B.C. properties will pass through Chambishi.

. . . . N'Changa drill hole No. B33, which cut the Dambo Lode horizon at 1,075 ft. and the River Lode horizon at 1,315 ft., appears to be very high grade, but the core recovery has been low and the assay results are therefore not so dependable. B23, about 1,200 ft. northwest of B33, has cut ore at a depth of 2,160 ft. This is the most northerly continuation of the high-grade N'Changa-R.C.B.C. orebody yet cut.

■

Kalgoorlie Mines Developing New Gold Deposits

Kalgoorlie, Western Australia, Nov. 29.—The gold mines at Kalgoorlie are developing new gold deposits which they hope can be treated profitably with the aid of the bonus on new gold production declared by the Australian federal government. South Kalgurli has almost completed driving the crosscut on the 1,200 level of its Croesus Proprietary lease. The company's engineers estimate that 70,000 tons of ore, averaging 8 dwt. in gold per ton, will be made available by this crosscut, which is 150 ft. below the deepest level from which the property's production has previously been obtained.

. . . . On the 1,750 level of the Great Boulder property, the vein has been cut for a width of 29 ft. and an average grade of 7.5 dwt. per ton. High-grade sections of the vein will average 13.5 dwt. per ton over minable widths. Enterprise Gold, one of the small developing companies, reports the discovery of a small tonnage that will average about 20 dwt. per ton on its 365 level.

. . . . Removal of the hoisting machinery from the Golden Horseshoe shaft to the Chaffers shaft of Lake View & Star has been completed, thus permitting an appreciable reduction in working costs, and profits have increased. For October, the earnings are estimated at £10,511, against £5,284 in September. Three 5-ton electric locomotives are now in operation on the 3,300 level, serving the Ivanhoe and Horseshoe sections. Production in October was 6,781 tons of company ore and 7,884 tons of lease ore. Additions to the 150-ton flotation unit that will bring its daily capacity up to 650 tons are now being made.

. . . . At Wiluna Gold, near Meekatharra, the majority of the ore-loading chutes have been installed and the treatment plant, with a capacity of 40,000 tons of ore monthly, is virtually complete. Production apparently will begin on schedule time about the first of the new year.

South African Output Totals for Ten Months Released

Johannesburg, Dec. 2.—Figures have just been released on the value of the mineral production of the Union of South Africa and of Southern Rhodesia during the first ten months of 1930. Excluding diamonds, minerals produced in South Africa during the period mentioned were valued at £42,139,913. Of this total, gold contributed £37,946,755; coal, £2,977,573; copper, £442,796; asbestos, £287,488; tin, £107,352; platinum, £89,153; silver, £70,914; osmiridium, £57,596; manganese, £49,990; and chrome, £39,665. For the entire year 1929, gold production was £44,228,748; coal, £3,777,722; copper, £720,887; asbestos, £497,393; tin, £246,254; platinum, £221,645; silver, £113,503; osmiridium, £87,243; manganese, £913; and chrome, £65,424. The only minerals in which an increase over 1929 levels has been registered, therefore, are gold and manganese. Sales of diamonds during the first six months were 1,285,409 carats, valued at £4,248,341.

. . . . The value of all minerals produced in Southern Rhodesia during the first ten months was put at £3,285,030, of which the gold output of 456,794 oz. accounted for more than half. The remainder was largely asbestos and chrome. Northern Rhodesia, during the first nine months of the year, produced £656,137 in minerals, largely copper from Bwana M'Kubwa and zinc from Rhodesia Broken Hill.

Johannesburg Consolidated's Assets Higher

Johannesburg, Nov. 28.—At the annual meeting of Johannesburg Consolidated, which is one of the leading finance houses on the Witwatersrand, the company's position was stated by S. B. Joel, the chairman, to be very satisfactory. Despite the abnormal depreciation in certain of the company's shareholdings, resulting from the crash on speculative exchanges, the total assets of the company are considerably higher than at the end of the previous fiscal year. Mr. Joel, in particular, expressed optimism as to the future of the copper companies operating in Northern Rhodesia, in several of which Johannesburg Consolidated has large holdings.

. . . . Directors of the company are in no way concerned in the depreciation of the share value of New Modderfontein Gold, A. W. Rogers, chairman of the company, stated at the annual meeting. In fact, Central Mining & Investment, the consulting engineers and controlling interest in the company, actually increased its holdings in the stock.

. . . . Activity is reported in the Leysdorp district, which is in the Murchison Range, Zoutpansberg, Transvaal. This is an old gold district, from which production was never large. Several new reefs have been found and are being energetically prospected.

■ ■ ■

Gertrudis Dividend Maintained; Bonus on Australian Gold

London, Dec. 1.—Santa Gertrudis directors have declared a final dividend payment of 7.5 per cent on the company's capital of £1,553,400, making the total payments for the year 15 per cent. This is the same amount as paid by the company last year and is a distinct surprise, as most investors in the stock did not expect a final payment of more than 5 per cent. In view of the precipitous decline in silver prices during the year, the showing of this Mexican silver producer is considered remarkable.

. . . . The Australian federal government has decided to pay a bonus of £1 per ounce on all gold produced in excess of 1929 production. The bonus is expected to attract many millions of British capital for the development of new discoveries in Queensland and the Northern Territory. Australian gold production has been falling steadily from its record of about 4,000,000 oz. in 1903, and in 1929 it was only 425,469 oz. Production returns for the first nine months of 1930 indicate an increase over the 1929 total.

. . . . Burma Corporation reports that its net profit for the third quarter of 1930 was only £65,000, owing to low metal prices. The profit for the year ended June 30 was £693,603. A cut in the dividend payment is expected, probably to only 2 annas, as compared with 7 annas paid last February.

. . . . At the Taquah & Abosso Mines, in the Wassau district, Gold Coast, the faults on levels Nos. 17 and 18 have been passed through and the workings are now in ore. On the No. 17 level, ore carrying 44.5s. per ton in gold has been cut over a width of 50 in., and on the No. 18 level, ore carrying 42.7s. per ton has been cut over a width of 45 in. This means the development of what is virtually an entirely new deposit of better grade than that at present being worked, which averages about 34s. a ton. The company has just declared its first dividend of 6¼ per cent on a capital of £250,000 in shares of 5s. par. Production is about 300 tons of ore daily.

. . . . Frontino & Bolivia is absorbing its subsidiary, Marmajito Mines, which operates gold-silver mines in Antioquia, Colombia. The shares will be exchanged on a basis of two Frontino preference shares for each of the Marmajito preference shares outstanding and seven Frontino ordinary shares for four Marmajito ordinary shares.

. . . . British Aluminium has issued privately 700,000 6 per cent non-cumulative preference shares of £1 par. The company is believed to be considering at present the issue of 2,500,000 first-mortgage 5 per cent debentures. Extensive plant improvements and increases in potential capacity are the object of this additional financing.

. . . . Interest in vanadium, steatite, and sillimanite, which are among the rarer metals and minerals, is increasing. Deposits in India and Australia are being examined by large British financial interests.

. . . . Mount Isa apparently may become a copper producer of some importance. Drill hole No. C4, at the mine in Queensland, has recently cut ore assaying 11.5 per cent copper for a width of 79 ft. at a depth of 993 ft. This ore is in the hanging wall of the main Black Star lead-zinc orebody. The hole is 400 ft. north of drill hole No. D1, which cut 25 ft. of 4 per cent copper at a depth of 1,000 ft. In addition, a copper orebody has been cut by two drill holes in the hanging wall of the Black Rock orebody. This deposit occurs in leached and broken ground, but the engineers believe that a good chance exists of finding below water level a valuable body of sulphide copper ore, capable of simple treatment. No provision for recovery of copper has yet been made in the Mount Isa metallurgical flow sheet.

. . . . Despite the low price of tin now prevailing, Alluvial Tin and Austral Malay report profits made from operations in October. These companies resumed production at the end of September after a two-month shutdown. Alluvial Tin had six dredges and Austral Malay, four dredges, working at a profit during October.

. . . . Rumors of a merger of Bwana M'Kubwa, N'Changa, and Rhodesian Congo Border have continued, and a meeting is said to be scheduled for next week. An increase in the capital structure of R.C.B.C. is expected.

■

Report Discovery New Method of Aluminum Insulation

Berlin, Nov. 29.—Aluminum sales continue poor and members of the European cartel are operating on a reduced scale. World aluminum stocks are large, being estimated at 150,000 tons. Research by the German government has succeeded in evolving a new process for insulating aluminum by oxidizing the metal electrolytically. The application of this process, which is licensed, is expected to be far-reaching, in that it will extend the use of aluminum in the automotive, building, and other industries. The import tariff on aluminum has been raised in Switzerland. Fear of "dumping" aluminum on the European market by Mellon interests usually serves as a bogey for a higher tariff on the metal.

. . . . American producers have succeeded in obtaining an interest in Yugoslavian Adria Bauxit D.D. of Drnis, and, according to reports, about 25 per cent of the bauxite output of the company will be reserved for American consumption. The German aluminum industry, on the other hand, in 1929 acquired the Yugoslavian aluminum mines of Sibenik, a mining concession at Sedramic, and formed the Bauxit-Kontinental, Ltd., at Zagreb. Recently a French-British group has located and acquired bauxite and iron-ore fields in the vicinity of Ribnica.

. . . . Both Trefileries du Havre and the American Smelting & Refining Company have denied the rumor that an electrolytic copper refinery is to be built in France.

. . . . The French company, Zinc de Guergour, has decided to suspend mining operations because of the low zinc prices; but the company intends to increase its capital at this time because of the cheapness of money. The Berzelius zinc smelter of Metallgesellschaft is again operating after the recent lockout. In spite of the business depression, Germany produced 7,303 metric tons of zinc during October, against 7,263 tons in September.

MARKET AND FINANCIAL NEWS

World Copper Production 152,544 Tons in October

Copper production of the world during October amounted to 152,544 short tons, against 152,405 tons (revised) in September, according to the American Bureau of Metal Statistics. Statistics issued by the bureau a month ago gave a total of 151,005 tons for September. The upward revision in the September figure, made in the latest compilation of world production statistics, resulted from the disclosure of data on output of Union Minière du Haut-Katanga, the African producer, at the conferences held in New York recently on the restriction of production. In the statistics for world production of copper, the production of Africa is included under the classification of "Elsewhere" as complete data are not available.

Production in the United States showed little change during October from the September rate. Canadian production for October was estimated at 8,573 tons, contrasted with 12,015 tons in September. The decline is attributed to curtailment in operations by both International Nickel and Noranda. Chile and Peru contributed 27,836 tons to the total for the month of October, against an output of 26,374 tons in September, and 26,937 tons in August. Braden, the Kennecott-controlled property in Chile, increased its output in August, and, according to reports, the increased rate was maintained through September and October.

■

Burma Corporation Earnings

Lower metal prices have cut earnings of Burma Corporation, operating the Bawdwin mine, in India, the annual report for the fiscal year ended June 30 reveals. During the last fiscal year, although production was higher than in the preceding year, the net profit after depreciation and taxes was £693,603, compared with £1,054,842 in the year ended June 30, 1929. After payment of dividends, the company's balance stands at £71,653, compared with £203,246. The company holds metal stocks valued at £259,972; investments, £632,978; sums owed to it, £285,410; and balances at banks and cash in hand of £621,490. Outstanding liabilities include debts of £204,523; income tax reserve, £517,800; and dividends declared, £380,860.

Production statistics follow, the figures in parentheses being for the 1929 fiscal year: Ore mined, 500,585 long tons (463,057); refined lead, 78,716 tons (79,267); silver, 7,225,881 oz. (7,347,333); zinc concentrate, 58,335 tons (60,180); and copper matte, 12,904 tons (10,719).

■

Copper Tariff Favored by Gordon R. Campbell

In announcing that Calumet & Arizona will reduce production 14 per cent from the present schedule of 7,500,000 lb. per month, Gordon R. Campbell, president, presents an argument for a tariff on copper. Further curtailment by C. & A. is necessary, he says, under present conditions, which permit foreign copper to be imported freely into the United States and sold in competition with American mined copper. Mr. Campbell's statement follows:

"Available statistics show that copper produced from American mines, including custom ores, for the first ten months of 1930, totaled 588,454 tons. Shipments to domestic consumers for the same period totaled 676,237 tons. Apparently, American consumption exceeds American mine production by 87,783 tons. Imports of copper in all forms for the first nine months of the year totaled 311,045 tons and exports were only 217,515. While American mines have been endeavoring to avoid excessive stocks and correct an unhealthy position, foreign mines added 93,530 tons to the burden, in nine months.

"Foreign mines have increased production in 1930 in the face of prevailing conditions and have forced American mines to decrease their operations in order to balance conditions and avoid actual ruin because it is cheaper to keep mines on a nominal basis than to close down completely.

"At this time when American employment is at such a low ebb, when so many of the citizens of the United States are out of employment, it is unfortunate that the mines of this country should be compelled to take this action on account of foreign invasion of the home market. It is the strongest argument yet offered for a substantial tariff on copper which will give American miners preference in their home market and will keep Americans employed. With a very little increase in business, American mines would be adding to the number of employed men instead of decreasing the number at this time, and would feel an assurance of security for the future that would enable them to employ men steadily in the future as in the past.

"Without protection, American copper mining will be in a sad way for years to come."

World Copper Production

(American Bureau of Metal Statistics)

Copper production of the world, based on copper content of blister, as reported by smelters without segregation according to countries of origin, in short tons, follows:

	June	July	Aug.	Sept.	Oct.	Jan.-Oct.
United States	69,155	67,638	66,698	68,487	70,419	732,169
Mexico	5,371	4,968	4,812	5,078	5,403	49,924
Canada	11,005	11,820	12,850	12,015	8,573	95,818
Chile and Peru	23,043	23,328	26,937	26,374	27,836	237,222
Japan	7,895	7,365	7,314	7,590	7,601	73,097
Australia	2,487	878	1,548	1,832	595	12,103
Germany	4,141	4,632	5,784	5,429	6,017	52,043
Other Europe (a)	11,400	11,368	11,200	11,500	11,600	111,968
Elsewhere (a)	11,300	12,000	12,700	14,100	14,500	118,700
World's totals	145,797	143,997	(b) 149,843	(b) 152,405	152,544	1,483,844

(a) Partly estimated. (b) Revised.

World's Copper Production by Months

	1928 Monthly Production	1928 Daily Rate	1929 Monthly Production	1929 Daily Rate	1930 Monthly Production	1930 Daily Rate
January	143,546	4,631	178,783	5,767	155,848	5,027
February	147,546	5,088	167,090	5,968	140,083	5,003
March	147,842	4,769	192,792	6,219	148,944	4,805
April	146,427	4,881	196,820	6,561	145,595	4,853
May	156,414	5,046	192,589	6,213	148,788	4,800
June	159,474	5,316	174,586	5,820	145,797	4,860
July	156,190	5,038	174,507	5,629	143,997	4,645
August	161,838	5,221	173,430	5,595	149,843	4,834
September	157,518	5,251	174,135	5,805	152,405	5,080
October	176,623	5,698	175,360	5,657	152,544	4,921
November	183,813	6,127	170,585	5,636	.....	.....
December	179,240	5,782	165,728	5,346	.....	.....
Totals	1,916,471	5,236	2,136,405	5,853	1,483,844	4,881
Monthly average	159,706		178,034		148,384	

World Lead Production Shows Little Change

World production of lead during October amounted to 152,016 tons, against 148,506 tons in September, and 170,306 tons in October, 1929, according to the American Bureau of Metal Statistics. The production total for October indicates that the rate of operations has undergone little change from the rate established in the preceding month. The daily rate for October was 4,904 tons, against 4,950 tons in September.

Production of lead, by countries, for August, September, and October, in tons, follows:

	Aug.	Sept.	Oct.
United States....	52,980	48,491	50,402
Canada	13,303	12,918	13,243
Mexico	22,563	21,583	23,308
Peru	1,070	1,084	1,077
Germany	11,235	11,322	9,604
Italy	1,806	2,048	2,583
Spain and Tunis*(a)*	9,163	9,007	9,040
Europe n.e.s*(b)*..	19,500	18,400	18,800
Australia	15,242	15,039	15,457
Burma	7,302	7,414	7,302
Elsewhere*(b)*	1,200	1,200	1,200
Total	155,364	148,506	152,016

*(a)*Partial. *(b)*Estimated or partly estimated.

■

Phelps Dodge-C. & A. Merger Postponed for Year

The merger of the Phelps Dodge Corporation and the Calumet & Arizona Mining Company will probably be postponed for a year, if it ever takes place, according to G. R. Campbell, president of Calumet & Arizona. In a statement made in Chicago recently, he said that many stockholders are opposed to the consolidation.

Copper production by Calumet & Arizona for 1930 would be around 95,000,000 lb., Mr. Campbell stated, against 130,000,000 lb. last year. Regarding fourth-quarter earnings, he held out little hope to stockholders that his company would be able to show a profit for the period.

New Dividends From Ontario

Two gold-mining companies in Ontario are joining the ranks of the dividend payers, although one of them, Wright-Hargreaves, has been among the élite before. The company, which operates at Kirkland Lake, has declared a payment of 5c. a share, payable on Jan. 2. It has 5,500,000 shares of stock outstanding. Dividends were paid during the period 1921-1928, but the necessity for an enlarged development program at the end of 1928 made suspension of dividend payments necessary. Sylvanite, also operating at Kirkland Lake, will record its initial disbursement with the payment of 2c. a share on its 3,299,500 shares of stock outstanding on Dec. 20. The company is a comparatively small producer, operating a 250-ton mill on $10 ore.

■

United States Silver Imports

Imports of silver in ore and base bullion during October totaled 4,210,695 oz., valued at $1,480,193; in refined bullion, 3,979,780 oz., valued at $1,419,608; and in coin, $317,640 of U. S. money and $52,500 of foreign currency. Corresponding figures in October, 1929, were 6,264,776 oz. in ore and base bullion, worth $3,212,649; 3,908,991 oz. in refined bullion, valued at $1,893,757; and $191,636 of U. S. and $104,882 of foreign coin. No silver was imported in any form from either India or China in October.

■

MEXICAN CORPORATION, operating the Teziutlan copper-zinc mine, in Mexico, reports a total loss, before deduction of reserves for depreciation and depletion, of $26,597 in the third quarter of 1930, compared with $15,077 in the second quarter. Gross return on concentrates produced from 15,937 tons of ore was $145,194.

E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920	130.92
1921	80.80
1922	93.94
1923	103.43
1924	102.63
1925	111.74
1926	107.74
1927	97.54
1928	99.78
1929	110.33

	1928	1929	1930
January	97.54	106.86	102.94
February	96.73	110.37	102.28
March	96.22	122.71	99.93
April	97.14	116.36	93.24
May	99.05	110.03	83.41
June	100.16	109.66	78.57
July	99.69	109.58	74.58
August	99.85	109.81	74.41
September	100.53	109.29	73.42
October	102.34	108.52	69.63
November	103.83	106.09	71.39
December	104.28	104.75	.....

■

October Zinc Production Holds at Steady Rate

Zinc production of the world has changed but little in recent months, based on returns from countries credited with about 75 per cent of the world's output. Production during October for all countries except Belgium, Poland, and the Netherlands totaled 92,606 tons, against 89,807 tons in September, and 93,185 tons in August. The daily rate for the month of October was 2,987 tons, against 2,993 tons in September.

Zinc production of the world so far as reported, in short tons, for September and October, according to the American Bureau of Metal Statistics, follows:

	September	October
United States	40,485	40,940
Mexico	2,633	2,913
Canada	10,065	11,046
Belgium	(c)	(c)
France	7,019	7,345
Germany (a)	8,006	8,050
Great Britain	4,225	4,247
Italy	1,736	1,911
Netherlands	(c)	(c)
Poland	(c)	(c)
Spain	988	1,023
Australia	4,939	5,208
Rhodesia	1,611	1,523
Elsewhere (b)	8,100	8,400
Totals	89,807	92,606

(a) Includes zinc dust. (b) Estimated. (c) Not reported.

■

Copper Dividends Reduced

Phelps Dodge Corporation has declared a quarterly dividend of 50c., placing the stock on a $2 annual basis, against $3 previously.

Nichols Copper Company has reduced its quarterly dividend from 75c. to 43¾c. a share on both its Class A and B stocks, placing them on an annual basis of $1.75 a share, against the former rate of $3.

Complete Market News and Prices

THE semi-monthly magazine you are now reading carries only a condensed review of important market news and price movements. For buyers and sellers of ores, metals, minerals, and scrap who require reliable information as soon as it is available, we now provide *Metal and Mineral Markets*, which goes to press at the close of the metal-market week each Wednesday. It is printed at high speed and is in the mails that evening. In compact form, ready for insertion in a ring binder, it is ideal for desk and reference use. It carries the standard *E.&M.J.* quotations used in contracts the world over, recognized as authoritative and dependable. *Metal and Mineral Markets* is priced to subscribers in the United States and its possessions at $2 per annum; to countries in the Americas but outside the United States, $5; elsewhere, $10 yearly: 52 issues. Address *M.&M.M.*, 36th St. and 10th Ave., N.Y.City.

Copper Sells Above 11c. in Quiet Market—Zinc, Tin, and Silver Easier

New York, Dec. 4, 1930.—The *E.&M.J.* weighted index number of non-ferrous metal prices for November was 71.39, a gain of 1.76 points for the month and the first advance since August, 1929. The slight advance reflected higher averages for both copper and zinc. Trading in all of the major metals during the last two weeks was quiet. Large copper producers continued to quote 12c., delivered, but the moderate tonnage sold was booked by custom smelters at prices ranging from 10¼c. to 11½c. Zinc was offered more freely and easier prices were named in several directions. Lead was firmly maintained, the price showing no variation either here or in St. Louis. The net change in the price of tin was insignificant. Silver was easier on sales by China. Quicksilver was available as low as $105 per flask. A little more buying interest was in evidence in antimony, through the price showed hardly any change.

Copper Sales Light

With the large fabricators well taken care of against first quarter 1931 requirements, the quiet that prevailed in copper during the last two weeks had little influence on the market. Leading producers appeared satisfied that conditions will gradually improve, because of the general curtailment in production, and held to the 12c. quotation named shortly after the agreement to restrict output was announced. Custom smelters had to dispose of their current intake and offered copper at a substantial reduction from the 12c. basis so as to attract business. Offerings of copper by second-hands had a depressing influence at times. The prices at which custom smelters sold copper ranged from 10½c. to 11½c., with 11½c. the trading basis on the last day of the period.

The export price held at 12.30c., c.i.f. European ports, though little business was placed at that figure. Toward the close there was a fair export demand for cathode and rough copper. November sales for export were large, totaling 71,000 long tons, against 67,500 long tons in October. The November total was the largest since last May.

Lead Quiet But Steady

Buying of lead was on a greatly reduced scale, but this failed to bring out any change in sentiment among sellers, and the undertone of the market was steady in all directions. The trading basis held at 5.10c., New York, the contract price of the American Smelting & Refining Company, and at 4.95c., St. Louis.

Domestic shipments of virgin lead during November fell somewhat short of expectations, the total for the month being estimated at 42,700 tons, a decline of about 500 tons from the total for October. The small November shipments may contribute to another moderate gain in stocks, notwithstanding the curtailment of production. This development, however, is not likely to influence sellers, as the decline in output is expected to make itself felt soon.

World output of lead by months for the first ten months of the current year, together with the daily rate, in tons, follows:

	Total	Daily Rate
January	153,772	4,960
February	148,298	5,296
March	163,177	5,264
April	153,779	5,126
May	157,270	5,073
June	150,541	5,018
July	151,356	4,882
August	155,364	5,012
September	148,506	4,950
October	152,016	4,904
Total	1,534,079	5,046

Zinc Lower

The tonnage of zinc sold was small. To attract buyers, producers offered Prime Western zinc at prices close to the low levels established about a month ago. Early in the period several lots brought 4.25c., St. Louis. Shortly before the close, however, business was transacted as low as 4.05c.

A meeting of the zinc group was held in Paris on Nov. 29 to straighten out quota difficulties in connection with forming a new agreement somewhat along the lines of the old cartel. The meeting was a complete failure, and the immediate outlook, so far as the foreign market is concerned, is indeed gloomy. The weakness in the domestic market is attributed in some quarters to uncertainty over the curtailment program reported here about a month ago.

Little Change in Tin

Both buyers and sellers of tin appear to be marking time. Sales here were light, and spot Straits tin ranged in price during the last two weeks from 25.75c. to 26.35c. per pound. The November statistics were just about in line with predictions, showing an increase in the so-called visible supply of 1,135 long tons. Advices from the Federated Malay States indicate that exports during December will be smaller, and, with the carry-over down a little, the visible at the end of the current month is expected to show a drop.

Silver Easier

Sales of silver by China have been the cause of a sagging market. The offerings were not large and chiefly absorbed for account of bear covering. India has been a buyer at the lower level, but most bids were at prices slightly under the market.

Average Metal Prices for November, 1930

COPPER:	
Electrolytic, refinery	10.113
London Standard Spot	46.134
London Electrolytic Spot	48.963
LEAD:	
New York	5.100
St. Louis	4.950
London Spot	15.934
London Forward	15.931
SILVER:	
New York	35.908
London	16.625
Sterling Exchange	485.454
ZINC:	
St. Louis	4.266
London Spot	14.706
London Forward	15.238
TIN:	
Straits	25.904
London Standard Spot	113.519
QUICKSILVER	106.717
ANTIMONY	7.105
PLATINUM:	
Refined	36.000
ALUMINUM 99 Per Cent Plus	23.300

Other Metals

Quotations cover wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., delivered, Alcoa commercial and mill ingot, 99 and 98 per cent, 23.30c.; Alcoa No. 12 alloy, 22c.; metallurgical ingot, 94 per cent plus, 23.30c.; 98@99 per cent, 22.90c. London, £85, less 2 per cent, per long ton, for 98 per cent ingots and bars.

ANTIMONY — Per lb., duty paid, Chinese spot, 7.10c.; futures, 7c. Market quiet.

BISMUTH—Per lb., $1.25. London, 5s., for lots of 500 lb. or more.

CADMIUM—Per lb., 70c. London, 1s. 10d.@2s.

IRIDIUM — Per oz., $190@$200 for 98@99 per cent sponge and powder. London, £37@£39.

NICKEL—Per lb., ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent), for single lots of spot metal. Contracts, 30@33c. London, per long ton, £170 @£175.

PALLADIUM — Per oz., $22@$23. London, £3 10s. to £4.

PLATINUM—Per oz., official price of leading interest continues at $36. Cash transactions between dealers several dollars less. The market is steady on moderate offerings.

QUICKSILVER—Per 76-lb. flask, $105 @$107. Demand continues moderate and prices are barely steady. London reports the market unsettled at £22 10s. per flask, with trading quiet.

RHODIUM—Per oz., $45@$50.

RUTHENIUM—Per oz., $36@$40.

Daily Prices of Metals

Nov. Dec.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
20	10.150@10.275	26.35	5.10	4.95	4.25
21	10.275	26.10	5.10	4.95	4.225
22	10.275	25.90	5.10	4.95	4.15
24	10.275	26.00	5.10	4.95	4.075@4.10
25	10.025@10.275	26.10	5.10	4.95	4.075@4.10
26	10.275	25.75	5.10	4.95	4.075@4.10
Av'ge	10.244	26.033	5.100	4.950	4.148
27	.....	.....	—Holiday—	.....	.....
28	10.275@10.525	25.875	5.10	4.95	4.075
29	10.525@10.775	25.75	5.10	4.95	4.075
1	10.775	26.00	5.10	4.95	4.075@4.10
2	11.275	25.825	5.10	4.95	4.075
3	11.025	25.75	5.10	4.95	4.05
Av'ge	10.825	25.840	5.100	4.950	4.073

Average prices for calendar week ended November 22, 1930, are: Copper, 10.765c.; Straits tin, 26.008c.; New York lead, 5.100c.; St. Louis lead, 4.950c.; Zinc, 4.260c.; and Silver, 35.917c.

Average prices for calendar week ended November 29, 1930, are: Copper, 10.350c.; Straits tin, 25.895c.; New York lead, 5.100c.; St. Louis lead, 4.950c.; Zinc, 4.083c.; and Silver, 35.425c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices of refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms or wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. The contract price for High-Grade zinc delivered in the East and Middle West is 1c. above the St. Louis price for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

Silver, Gold, and Sterling Exchange

Nov.	Sterling Exchange "Checks"	Silver		Gold, London	Nov. Dec.	Sterling Exchange "Checks"	Silver		Gold, London
		New York	London				New York	London	
20	4.85 9/16	36	16 11/16	85s1 d	27	Holiday	Holiday	16 9/16	85s1 1/2d
21	4.85 7/16	35 7/8	16 5/8	85s1 1/2d	28	4.85 5/16	35 3/8	16 7/16	85s1 1/2d
22	4.85 3/8	35 3/4	16 5/8	.....	29	4.85 1/4	35 1/4	16 5/16	.....
24	4.85 7/16	35 5/8	16 1/2	85s1 1/2d	1	4.85 1/4	34 7/8	16 1/4	85s1 1/2d
25	4.85 3/8	35 1/2	16 1/2	85s1 1/2d	2	4.85 3/8	34 3/4	16 1/16	85s2 d
26	4.85 3/8	35 1/2	16 1/2	85s1 1/2d	3	4.85 3/8	34 3/4	16 3/16	85s1 1/2d

Average for week ended November 26: Silver, 35.708c.; Sterling Exchange, $4.85427.
Average for week ended December 3: Silver, 34.975c.; Sterling Exchange, $4.85313.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis of 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command five-thirty-seconds cent premium.

London

Nov. Dec.	Copper Standard		Electrolytic (Bid)	Tin		Lead		Zinc	
	Spot	3 M		Spot	3 M	Spot	3M	Spot	3 M
20	45 9/16	45 9/16	49	116	117 1/4	16 1/16	15 15/16	14 3/4	15 1/4
21	46 1/4	46 1/2	52	114 3/4	116 1/2	15 13/16	15 3/4	14 3/8	15 1/4
24	47 3/4	47 3/4	52	113 7/8	114 7/8	15 13/16	15 7/8	14 11/16	15 1/8
25	47 1/4	47 3/8	52	113 1/4	115 1/2	16 1/16	15 15/16	14 3/8	15
26	47 1/2	47 1/2	51	114 1/8	115 3/8	16 1/16	15 15/16	14 3/16	14 11/16
27	47 1/2	47 5/8	51	114	115 3/8	16	15 15/16	14 5/16	14 11/16
28	47	47	51	114 7/8	116	16 3/16	16	14 5/16	14 11/16
1	48 1/4	48 3/8	51 1/2	114 7/8	116 1/8	15 7/8	15 13/16	14 5/16	14 11/16
2	50 3/8	50 3/8	55	114 1/2	115 1/2	15 7/8	16	14 7/16	14 11/16
3	49 1/4	49 1/4	55	114 3/8	115 3/8	15 3/4	15 7/8	14 3/16	14 3/4

Prices for lead and zinc are the official prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

Chromium, Cobalt, Magnesium, Manganese, Molybdenum, Osmium, Radium, Selenium, Silicon, Tantalum, Tellurium, Thallium, and Tungsten are unchanged from prices given in the Nov. 24 issue.

Metallic Ores

Prices in tons of 2,000 lb., or in "Units" of 20 lb., unless otherwise stated.

CHROME ORE—Per long ton, c.i.f. Atlantic ports, Russian and Indian ores, 46 to 48 per cent Cr_2O_3, $19.50. Other prices as in Nov. 24 issue.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, cargo lots, exclusive of duty of 1c. per lb. of Mn contained, Indian, 48 to 50 per cent, 27@28c.; South African, 52 to 54 per cent, 27@28c. Caucasian, 52@55 per cent, 27@28c. per long ton unit.

TUNGSTEN ORE—Per unit of WO_3, New York: Chinese wolframite, duty paid, $12.50. Bolivian scheelite, $12.25; domestic scheelite, $13@$13.50.

Antimony, Beryllium, Iron, Molybdenum, Tantalum, Tin, Titanium, Vanadium, and Zircon ores are unchanged from prices given in the Nov. 24 issue.

Non-Metallic Minerals

Non-metallic mineral quotations are unchanged from those given in the issue of Nov. 24.

Refractories

Refractories are unchanged from the prices given in the Nov. 24 issue.

Alloys

Alloys are unchanged from prices given in the Nov. 24 issue.

Metallic Compounds

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c., delivered, all positions.

COPPER SULPHATE (Blue Vitriol)—Per lb., in car lots, 4.25c. for either large or small crystals.

For prices on calcium molybdate, cobalt oxide, germanium dioxide, sodium nitrate, sodium sulphate, zinc oxide, and zirconium dioxide see issue of Nov. 24.

Rolled Metals

COPPER—Per lb., sheets, hot-rolled, 21¾c.; wire, f.o.b. mill, 13¾c.

LEAD SHEETS—Per lb., full rolled, 8c.; clipped, 8¼c.

MONEL METAL—Per lb., sheets, full finished, 42c.; rods, hot-rolled, 35c.

MUNTZ METAL—Per lb., rods, 17⅞c.; plates, 20⅜c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

NICKEL SILVER—Per lb., sheets, 10 per cent, 26@26½c.; 18 per cent, 29½@29¾c. Wire and rods, 10 per cent, 29½c.; 15 per cent, 33¼c.; 18 per cent, 36¾c.

PHOSPHOR BRONZE—Per lb., sheets and rods, 5 per cent tin, 33c.; wire, 5 per cent, 33½c.; 10 per cent, 39c.

ZINC SHEETS—Per lb., 9½c., f.o.b. works; ribbon, 9c.; 7 per cent discount on orders for 18 tons or more.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1929	1930	1929	1930	1929	1930
January	57.019	45.000	26.257	20.896	484.577	486.447
February	56.210	43.193	25.904	20.008	484.787	485.784
March	56.346	41.654	26.000	19.298	484.776	485.933
April	55.668	42.428	25.738	19.554	484.808	486.019
May	54.125	40.736	25.084	18.850	484.599	485.724
June	52.415	34.595	24.258	16.049	484.330	485.625
July	52.510	34.346	24.289	15.928	484.560	486.300
August	52.579	35.192	24.288	16.283	484.368	486.839
September	51.042	36.315	23.708	16.738	484.253	485.888
October	49.913	35.846	23.042	16.563	486.392	485.719
November	49.615	35.908	22.690	16.625	487.104	485.454
December	48.475	.....	22.258	.....	487.523	.....
Year	52.993	.....	24.460	.....	485.173	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery		London Spot			
	Electrolytic		Standard		Electrolytic	
	1929	1930	1929	1930	1929	1930
January	16.603	17.775	75.551	71.469	78.602	83.250
February	17.727	17.775	78.228	71.419	83.538	83.500
March	21.257	17.775	89.153	69.202	98.356	83.405
April	19.500	15.621	81.036	62.075	89.405	74.338
May	17.775	12.756	75.026	53.159	83.727	59.545
June	17.775	12.049	74.338	50.003	84.013	56.750
July	17.775	11.023	72.152	48.277	84.043	52.522
August	17.775	10.693	73.783	47.525	84.250	50.725
September	17.775	10.310	75.286	46.264	84.363	49.500
October	17.775	9.597	72.815	43.030	83.978	45.772
November	17.775	10.113	69.324	46.134	82.202	48.963
December	17.775	.....	68.303	.....	82.569	.....
Year	18.107	.....	75.416	.....	84.921	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1929	1930	1929	1930	1929 Spot	1929 3 Mos.	1930 Spot	1930 3 Mos.
January	6.650	6.250	6.498	6.100	22.111	22.344	21.545	21.571
February	6.853	6.236	6.739	6.086	23.128	23.156	21.188	21.097
March	7.450	5.662	7.348	5.542	25.409	25.591	18.807	18.940
April	7.187	5.537	7.025	5.428	24.783	24.408	18.319	18.363
May	7.000	5.523	6.761	5.408	23.949	23.750	17.795	17.861
June	7.000	5.410	6.790	5.310	23.694	23.603	17.941	17.994
July	6.804	5.250	6.607	5.149	22.810	22.880	18.160	18.063
August	6.750	5.488	6.553	5.340	23.185	23.259	18.294	18.178
September	6 890	5.500	6.689	5.348	23.557	23.589	17.909	17.798
October	6.873	5.151	6.674	4.999	23.226	23.253	15.747	15 674
November	6.285	5.100	6.135	4.950	21.622	21.643	15.934	15.931
December	6.250	.....	6.100	.....	21.472	21.484	.....	.....
Year	6.833	.....	6.660	.....	23.246	23.247	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1929	1930	1929	1930
	Straits		Spot	
January	49.139	38.851	222.727	175.460
February	49.347	38.676	223.138	173.750
March	48.870	36.798	220.781	164.851
April	45.858	36.077	206.887	162.638
May	43.904	32.108	197.545	144.818
June	44.240	30.336	200.206	136.300
July	46.281	29.822	209.473	134.511
August	46.619	30.044	209.815	134.988
September	45.359	29.647	204.863	132.631
October	42.290	26.802	190.783	117.451
November	40.208	25.904	180.565	113.519
December	39.745	.....	179.419	.....
Year	45.155	.....	203.850	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1929	1930	1929 Spot	1929 3 Mos.	1930 Spot	1930 3 Mos.
January	6.350	5.229	26.196	26.233	19.634	20.241
February	6.350	5.180	26.247	26.347	19.209	19.778
March	6.463	4.934	27.050	27.294	18.304	18.810
April	6.658	4.843	26.759	26.613	17.819	18.378
May	6.618	4.641	26.727	26.619	16.639	17.330
June	6.686	4.441	26.216	25.984	16.422	17.038
July	6.766	4.350	25.332	25.418	16.171	16.777
August	6.800	4.360	24.896	25.164	15.953	16.469
September	6.799	4.270	24.208	24.688	15.773	16.080
October	6.740	4.059	22.927	23.329	14.446	14.935
November	6.242	4.266	20.851	21.351	14.706	15.238
December	5.666	.....	20.072	20.672	.....	.....
Year	6.512	.....	24.790	24.976	.....	.....

St. Louis quotations, cents per pound. London pounds sterling per long ton.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1929	1930	1929	1930	1929	1930
January	9.558	8.606	119.481	121.192	70.000	61.923
February	9.548	8.830	119.818	120.500	70.000	59.909
March	9.531	8.236	121.904	118.808	70.000	54.769
April	9.462	7.740	122.000	114.000	70.000	46.462
May	8.957	7.454	121.154	117.269	68.615	46.000
June	8.845	7.057	120.500	118.600	68.000	46 000
July	8.543	6.976	121.654	117.462	68.000	43.692
August	8.778	7.839	125.111	116. 00	68.000	41.462
September	8.709	7.773	124.542	113.620	66.000	36.080
October	8.538	7.288	124.298	110.596	65.000	36 000
November	8.583	7.105	123.323	106.717	65.000	36.000
December	8.420	.....	121.950	.....	63.240	.....
Year	8.956	.....	122.145	.....	67.655	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce.

Pig Iron[1] and Aluminum

	Bessemer		Basic		No. 2 Foundry		Aluminum	
	1929	1930	1929	1930	1929	1930	1929	1930
Jan	18.00	19.00	17.50	18.50	17.50	18.50	24.300	24.300
Feb	18.00	19.00	17.50	18.50	17.50	18.50	24.300	24.300
March	18.19	19.00	17.62	18.50	17.69	18.50	24.300	24.300
April	18.50	19.00	18.00	18.50	18.00	18.50	24.300	24.300
May	18.81	19.00	18.31	18.50	18.31	18.50	24.300	24.300
June	19.00	19 00	18.50	18 50	18.50	18 50	24.300	24.140
July	19.00	18.62	18.50	18 12	18.50	18 12	24.300	23.300
Aug	19.00	18 50	18.50	18 00	18.50	18 00	24.300	23.300
Sept	19.00	18 38	18.50	17 76	18.50	17 88	24.300	23.300
Oct	19.00	17 85	18.50	17 00	18.50	17 22	24.300	23.300
Nov	19.00	17.50	18.50	17.00	18.50	17.00	24.300	23.300
Dec	19.00	.....	18.50	....	18.50	.....	24.300	.....
Year	18.71	....	18.20	.....	18.21	....	24.300	....

Iron in dollars per long ton. Aluminum in cents per pound, 99 per cent grade.

[1]F.o.b. Mahoning and Shenango valley furnaces; freight to Pittsburgh, $1.76.

Monthly Crude Copper Output in Short Tons

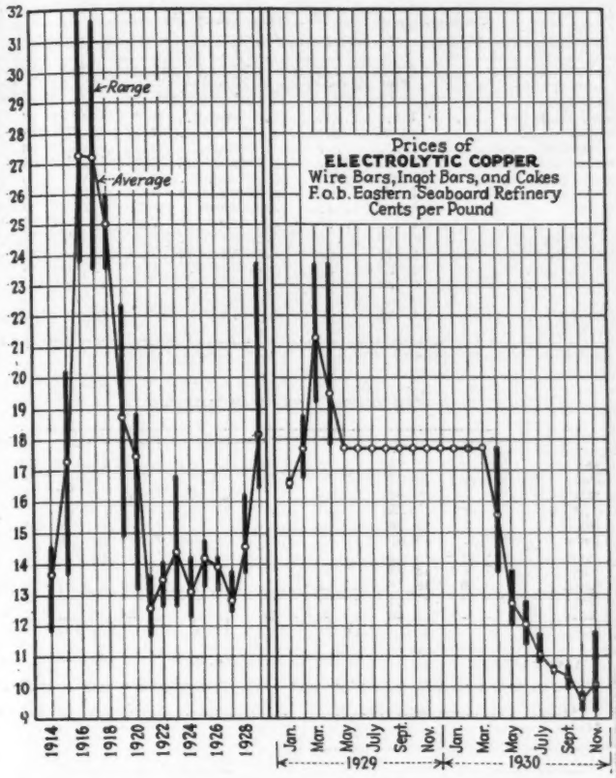
	1929 Total	1930 June	July	Aug.	Sept.	Oct.
Domestic						
Alaska shipments	21,947	1,250	1,673	486	2,223	2,438
Calumet & Arizona	65,246	3,939	3,767	3,758	3,730	3,836
Magma	19,118	1,150	674	1,494	1,577	1,623
Miami	29,567	2,893	2,675	3,035	2,701	2,798
Nevada Cons.	133,140	(d) 17,870	.....	.....	(d) 16,686	.....
Old Dominion(a)	11,172	845	722	929	756	781
Phelps Dodge	111,026	6,037	5,755	6,262	6,014	6,015
United Verde Extens.	29,669	1,790	1,949	2,014	1,886	1,702
Utah Copper	148,312	(f)	.....	.....	(f)	.....
Tennessee Copper	7,870	596	615	622	597	656
Foreign						
Andes Copper	83,718	3,936	3,935	3,614	.....	.....
Braden	88,155	5,818	5,824	8,200	.....	.....
Boleo, Mexico	13,196	(d) 3,636	.....	.....	(d) 3,537	.....
Bwana M'Kubwa	6,988	501	551	598	617	571
Chile	150,247	7,486	7,480	6,803	.....	.....
Furukawa, Japan	17,767	1,511	1,413	1,626	1,642	.....
Granby, Cons., Canada	30,424	2,204	2,066	2,330	2,333	1,882
Howe Sound	21,516	(d) 5,698	.....	.....	.....	.....
Messina	(e) 7,200	729	711	734	824	780
Mt. Lyell	7,600	(d) 2,090	.....	.....	.....	.....
Sumitomo, Japan	20,180	1,687	1,666	1,537	1,110	.....
Union Minière, Africa	151,006	(e) 72,800	.....	.....	.....	.....

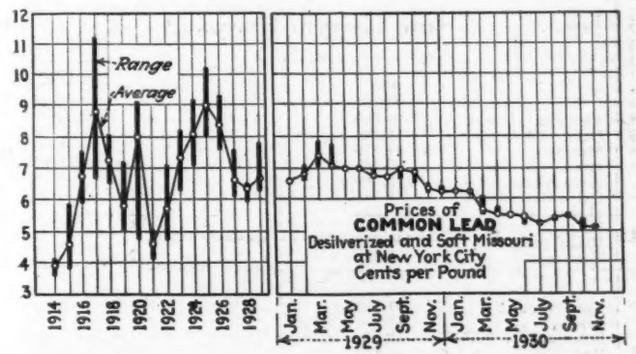
(a) Includes Arizona Commercial. (b) Moctezuma is included. (c) Estimated. (d) Three months. (e) Six months. (f) Not reported.

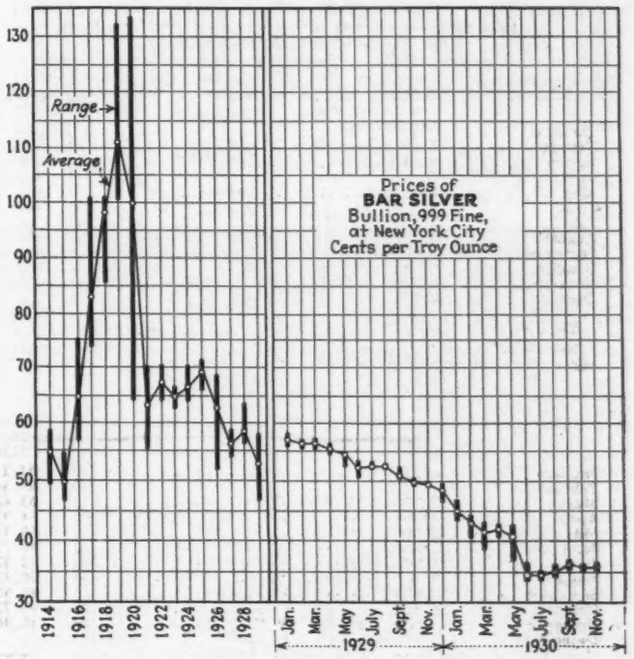
Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

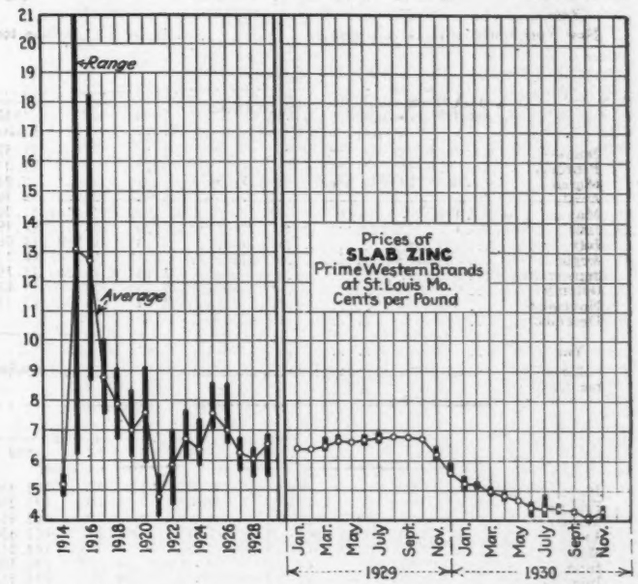
	1928		1929		1930	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	68,469	2,209	86,324	2,785	67,838	2,188
February	67,423	2,352	84,735	3,026	59,196	2,114
March	70,327	2,269	93,698	3,023	61,216	1,975
April	69,721	2,324	94,902	3,163	60,450	2,015
May	73,729	2,378	93,392	3,013	60,238	1,943
June	73,224	2,441	82,354	2,745	56,743	1,891
July	73,426	2,369	79,229	2,556	54,249	1,750
August	76,952	2,482	78,885	2,545	56,779	1,832
September	78,341	2,611	79,402	2,647	56,584	1,886
October	86,480	2,790	82,575	2,664	55,804	1,800
November	85,382	2,846	75,934	2,531	.....	.....
December	85,677	2,764	74,772	2,412	.....	.....
Total	909,051	.....	1,006,203	.....	588,458	.....
Monthly average	75,754	.....	83,850	.....	58,845	.....
Av. of daily rate	.....	2,484	.....	2,757	.....	1,936

Metal Price Curves

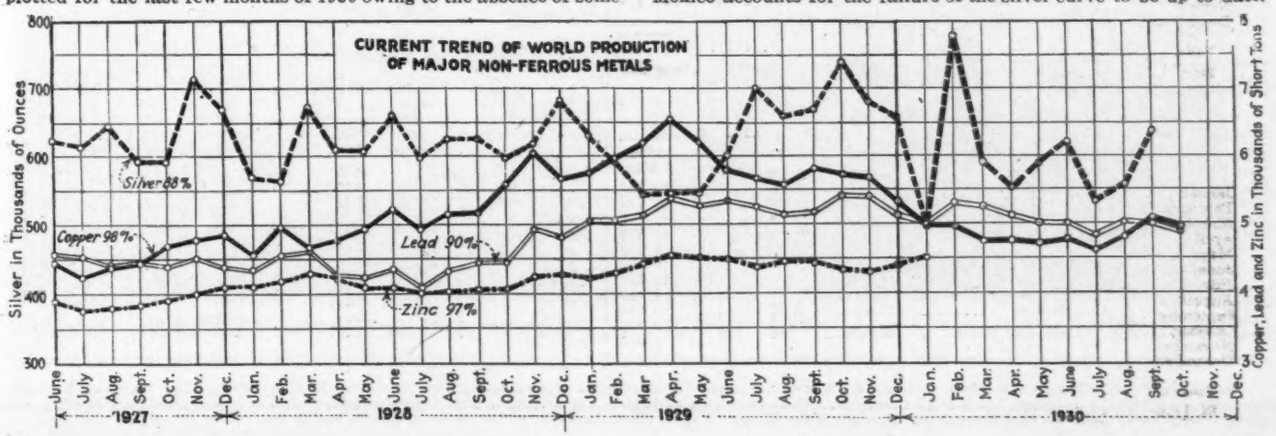








THE CURVES below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce approximately 98 per cent of the world's copper, 97 per cent of the zinc, 90 per cent of the lead, and 88 per cent of the silver. The zinc curve has not been plotted for the last few months of 1930 owing to the absence of some European production statistics; this situation is believed to be only temporary in character. Delay in receipt of statistics from Mexico accounts for the failure of the silver curve to be up to date.


CURRENT TREND OF WORLD PRODUCTION
OF MAJOR NON-FERROUS METALS
Silver in Thousands of Ounces
Copper, Lead and Zinc in Thousands of Short Tons
Silver 88%
Copper 98%
Lead 90%
Zinc 97%
June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1927
1928
1929
1930

Mining Share Prices—Month of November, 1930

Company Name	Metals Produced	Location of Properties	High	Low	Last
NEW YORK STOCK EXCHANGE					
Ahumada Lead	Lead silver	Mexico	0.50	0.37½	0.37½
Alaska Juneau	Gold	Alaska	6.62½	5.62½	6.25
Am. Metal	Lead, silver, zinc	Various	24⅞	20⅛	21⅛
Am. Metal, pfd	Copper, gold	Various	99	96	96
Am. Sm. & Ref	Lead, copper, silver	Various	56⅜	45⅜	51⅞
Am. Sm. & Ref., 2d pfd.	Gold, zinc	Various	100½	97⅜	98½
Am. Sm. & Ref., pfd.			136½	131½	131½
Am. Zinc, L. & S.	Zinc, lead	Various	7.87½	4.12½	6.00
Am. Zinc, L. & S., pfd.			.....	.....	49*
Anaconda	Copper, zinc, silver	Various	41⅛	33½	36½
Andes Copper	Copper, silver	Chile	21	14¼	17¼
Butte C. & Z.	Manganese, zinc	Montana	2.00	1.50	1.75
Butte & Superior	Zinc, silver	Montana	1.50	1.00	1.12½
Callahan Zinc-Lead	Lead, zinc	Idaho	0.87½	0.75	0.75
Cal. & Arizona	Copper, gold, silver	Arizona	42	32	36⅜
Cal. & Hecla	Copper	Michigan	13⅞	8.00	10⅛
Cerro de Pasco	Copper, silver, lead	Peru	34	25½	28
Dome Mines	Gold	Ontario	8.75	8.00	8.25
Federal M. & S.	Lead, zinc, silver	Idaho	90	80	90
Federal M. & S., pfd.		Tri-State	100	100	100
Freeport Texas	Sulphur	Texas	34½	29½	32½
Granby Con.	Copper, silver, gold	Brit. Col.	21⅛	12	18
Greene Cananea	Copper, silver, gold	Mexico	60	47⅜	60
Homestake	Gold	So. Dakota	80	78½	80
Howe Sound	Copper, lead, zinc	Various	27½	20	22½
Inspiration	Copper	Arizona	14	8	10
International Nickel	Nickel, copper	Ontario	20½	17	18⅜
Int. Nickel, pfd.			121	120	120
Kennecott	Copper, gold, silver	Various	32½	24½	28½
McIntyre-Porcupine	Gold	Ontario	18½	17⅜	17⅜
Magma Copper	Copper, silver, gold	Arizona	28	20½	24
Miami Copper	Copper	Arizona	13½	7.37½	9.87½
Mother Lode	Copper, silver	Alaska	0.87½	0.62½	0.87½
National Lead	Lead, zinc	Various	127	115	120
National Lead, pfd. A			143	141	141
National Lead, pfd. B			120	118	120
Nevada Con.	Copper, gold, silver	Various	15	9.37½	11⅜
Park Utah Con.	Zinc, silver, lead	Utah	2.37½	1.25	1.62½
Patiño M. & E.	Tin	Bolivia	12⅜	10½	11⅜
Phelps Dodge	Copper, gold, silver	Various	29	20¼	27½
Rand Mines	Gold	Africa	.....	.....	32*
St. Joseph Lead	Lead, zinc, silver	Various	32½	25½	27½
Seneca Copper	Copper	Michigan	2.50	1.50	1.62½
Tennessee C. & C.	Copper, su. acid	Tennessee	11	9.00	10½
Texas Gulf	Sulphur	Texas	53⅛	47½	53½
U. S. S. R. & M.	Silver, gold, lead	Various	24	20½	23½
U. S. S. R. & M., pfd.	Zinc, copper		43	42	42
Utah Copper	Copper, gold, silver	Utah	.....	.....	148*
Vanadium Corp.	Vanadium, ilmenite	Various	59¾	44¾	53½
NEW YORK CURB EXCHANGE					
Aluminum Co. of Am.	Aluminum	Various	204½	150	163
Alum. Co. of Am., pfd.			109	108	108⅜
Anglo-Chilean Con.	Nitrate	Chile	20	13½	14⅜
Bunker H. & S.	Lead, silver, zinc	Idaho	53⅛	50⅜	50⅜
Carnegie Metals	Silver, gold	Mexico	4.50	4.50	4.50
Con. Coppermines	Copper, gold, silver	Nevada	4.50	2.50	3.00
Copper Range	Copper	Michigan	7.50	6.50	6.75
Cresson Con.	Gold	Colorado	0.31½	0.25	0.31½
Cusi Mexicana	Lead, zinc, silver	Mexico	0.62½	0.50	0.62½
Evans-Wallower	Lead, zinc	Various	1.62½	0.62½	1.00
Federated Metals	Trading	Various	12½	10	10
Hecla Mining	Lead, silver, zinc	Idaho	10	9.00	9.62½
Hollinger Con.	Gold	Ontario	6.25	5.62½	6.25
Hudson Bay M. & S.	Copper, zinc	Manitoba	6.62½	3.50	5.25
Iron Cap Copper	Copper, silver, gold	Arizona	1.12½	1.00	1.00
Mayflower Assoc.	Holding	Various	44⅜	40	40
Mining Corporation	Silver, lead, zinc	Canada	1.62½	0.75	1.62½
New Jersey Zinc	Zinc, lead, silver	Various	58⅛	48½	50½
Newmont Mining	Holding, copper, gold	Various	63⅛	50	56⅛
N. Y. and Honduras	Silver, gold	Honduras	10	10	10
Nipissing	Silver	Ontario	1.25	1.00	1.12½
Noranda Mines	Copper, gold, silver	Quebec	20½	14½	17
Ohio Copper	Copper, lead, gold	Utah	0.50	0.37½	0.37½
Premier Gold	Silver, gold	Brit. Col.	0.87½	0.62½	0.75
Quincy	Copper	Michigan	7.75	6.00	6.00
Shattuck Denn	Copper, gold, silver	Arizona	4.62½	2.75	3.87½
So. Am. Gold & Plat.	Platinum, gold	Colombia	1.25	1.00	1.25
Teck-Hughes	Gold	Ontario	6.00	5.25	5.62½
Tonopah Mining	Silver, gold, copper	Various	0.50	0.50	0.50
United Eastern	Silver, lead	Mexico	.....	.....	0.06½*
United Verde Ex.	Copper, gold, silver	Arizona	8.37½	7.12½	7.87½
United Zinc Sm.	Lead, zinc	Tri-State	.....	.....	3.50*
Utah-Apex	Lead, zinc, copper	Utah	1.75	1.25	1.25
Yukon Gold	Gold	Yukon	0.25	0.25	0.25
BOSTON STOCK EXCHANGE					
Ariz. Commercial	Copper, gold, silver	Arizona	1.75	1.12½	1.37½
East Butte	Copper, gold	Montana	1.75	1.12½	1.75
Isle Royale	Copper	Michigan	7.37½	4.25	7.00
Mohawk Mining	Copper	Michigan	24½	19½	23
Old Dominion	Copper, gold, silver	Arizona	4.50	3.25	3.75
Utah Met. & Tunnel	Copper, lead, gold	Utah	0.35	0.25	0.25
MONTREAL					
Asbestos Corp.	Asbestos	Quebec	0.50	0.25	0.50
Asbestos Corp., pfd.			1.00	1.00	1.00
Consolidated M. & S.	Lead, zinc, silver	Canada	158	130	145

Company Name	Metals Produced	Location of Properties	High	Low	Last
TORONTO STANDARD STOCK AND MINING EXCHANGE					
Abana Mines	Copper, zinc, silver	Quebec	0.29	0.20	0.21
Amulet Mines	Copper, zinc, silver	Quebec	0.43	0.26	0.33
Base Metals	Lead, zinc, silver	Brit. Col.	1.76	1.20	1.31
Barry-Hollinger	Gold	Ontario	0.08½	0.07	0.08
Canam Metals	Lead, zinc, silver	Various	0.12	0.12	012
Castle-Trethewey	Silver	Ontario	0.18	0.15	0 18
Central Manitoba	Gold	Manitoba	0.06½	0.04½	0.05
Falconbridge	Nickel, copper	Ontario	2.00	1.20	1.50
Howey Mines	Gold	Ontario	0.25	0.14	0.21
Keeley	Silver	Ontario	0.28	0.27	0.27
Kirkland Lake	Gold	Ontario	0.47	0.35	0.45
Lake Shore	Gold	Ontario	22	20½	21¼
Sherritt Gordon	Copper, zinc, silver	Manitoba	1.04	0.55	0.85
Siscoe Gold	Gold	Quebec	0.35	0.30	0.35
Sylvanite	Gold	Ontario	0.63	0.54	0.55
Treadwell Yukon	Lead, zinc, silver	Various	1.00	0.75	1.00
Ventures	Holding	Various	0.57	0.40	0.42
Vipond Con.	Gold	Ontario	0.93	0.85	0.86
Waite-A.-M.	Copper, zinc, gold	Quebec	2.00	2.15	2.25
Wright-Hargreaves	Gold	Ontario	1.82	1.56	1.66
ST. LOUIS, CINCINNATI, AND DENVER					
Consolidated L. & Z.	Lead, zinc	Tri-State	2.50	2.50	2.50
Eagle-Picher	Lead, zinc, silver	Various	6.87½	5.75	5.87½
Eagle-Picher, pfd.			100	100	100
Empire Chief	Lead, zinc, silver	Colorado	0.02½	0.01½	0.02
New El Paso	Gold	Colorado	.....	.....	0.03*
Star of Utah	Lead, zinc, silver	Utah	0.70	0.60	0.70
Tungsten Production	Tungsten	Colo., Nev.	0.14	0.11	0.11
SAN FRANCISCO, LOS ANGELES, AND COLORADO SPRINGS					
California Copper	Copper, gold, silver	California	1.00	0.62½	0.75
Golden Cycle	Gold	Colorado	0.11½	0.11½	0.11½
Idaho-Maryland	Gold	California	0.26	0.17	0.19
Portland	Gold	Colorado	0.00½	0.00½	0.00½
Tom Reed	Gold	Arizona	0.72	0.62	0.63
United Gold	Gold	Colorado	0.07½	0.07	0.07
SPOKANE					
Constitution	Lead, zinc, silver	Idaho	0.11½	0.06	0.06½
Dayrock	Lead, silver	Idaho	1.35	1.00	1.20
Golconda	Lead, zinc, silver	Idaho	0.35	0.33	0.34½
§Jack Waite Mines	Lead, zinc, silver	Idaho	0.24½	0.18½	0.23½
Mexican Premier	Lead, silver, gold	Mexico	0.23	0.19	0.20½
Montana Mines	Gold, silver	Montana	0.20	0.15	0.15
Noble Five	Lead, zinc	Brit. Col.	0.04	0.01	0.04
Pend Oreille	Zinc, silver, lead	Wash	0.70	0.60	0.65
Sherman Lead	Lead, silver	Idaho	0.46	0.40	0.44
Sunshine Mining	Silver, lead, copper	Idaho	2.05	1.71	2.02
Tamarack & Custer	Lead, silver	Idaho	0.33	0.29	0.31
SALT LAKE CITY					
Chief Con.	Lead, silver, gold	Utah	0.80	0.60	0.76
Combined Metals	Zinc, lead, silver	Various	0.15	0.09½	0.13
Eureka Bullion	Lead, silver, gold	Utah	0.25	0.15	0.23
Eureka Lilly	Lead, silver, gold	Utah	0.23½	0.19½	0.23
Moscow Silver	Silver, lead	Utah	0.75	0.50	0.50
New Quincy	Lead, silver, zinc	Utah	0.08½	0.03½	0.08½
North Lily	Lead, silver, gold	Utah	1.25	0.76	1.20
Park Bingham	Lead, zinc, silver	Utah	0.01½	0.00½	0.00½
Park City Con.	Lead, zinc, silver	Utah	0.29½	0.23	0.25
Rico Argentine	Zinc, lead, silver	Colorado	0.05	0.03½	0.04
Silver King Coal	Lead, silver, zinc	Utah	6.70	6.25	6.25
Tintic Lead	Lead, silver, copper	Utah	1.37½	1.20	1.37½
Tintic Standard	Lead, gold, silver	Utah	5.50	4.90	5.50
Walker Mining	Copper, gold, silver	California	2.40	1.60	1.97½
‡LONDON					
Anglo American	Holding	Various	17/4½	15/–	15/7½
Aramayo Mines	Tin, bismuth, silver	Bolivia	23/9	20/7½	21/3
Burma Corporation	Lead, silver, zinc	India	10/7½	9/6	9/10½
Bwana M'Kubwa	Copper	Rhodesia	9/10½	8/3	8/9
Camp Bird	Holding	Various	7d	4½d	6d
Fresnillo	Silver, lead, zinc	Mexico	8/3	8/3	8/3
Frontino & Bolivia	Gold	Colombia	8/3	8/–	8/–
Lake View & Star	Gold	Australia	9/1½	7/6	8/6
Mexican Corporation	Copper, zinc	Mexico	4/9	3/–	4/3
N'Changa Copper	Copper	Rhodesia	46/3	36/3	42/6
Oroville Dredging	Gold	California	1/11	1/9½	1/10½
Rhodes. Congo Border	Copper	Rhodesia	222/6	180/–	182/6
Rhodes.-Select. Trust	Copper	Rhodesia	22/6	16/6	18/1½
Rio Tinto	Copper, pyrites	Spain	677/6	595/–	630/–
St. John del Rey	Gold	Brazil	17/10½	16/9	17/6
San Francisco Mines	Zinc, lead, silver	Mexico	17/–	13/10½	16/6
Santa Gertrudis	Silver, gold	Mexico	9/6	7/6	9/–
Selukwe	Holding	Africa	3/4½	2/1½	3/3
So. American Copper	Copper	Venezuela	1/7½	1/4	1/4½
Tanganyika	Holding	Africa	31/6	22/6	28/9
Wiluna Gold	Gold	Australia	15/6	13/6	15/–
Union Minière	Copper	Bel.Congo	6,610	5,500	6,375†

Salt Lake Stock Exchange courtesy J. A. Hogle & Company, Toronto Standard Stock Exchange courtesy the Arthur E. Moysey Company, Spokane Standard Exchange courtesy the Pohlman Investment Company. *Not traded in. †Belgian Francs. ‡The above London quotations are for the month ended Nov. 20. §Jack Waite Consolidated has been reorganized into Jack Waite Mines. The old stock shares are exchangeable into new stock at the ratio of five old for one new.